HONOLULU FIRE DEPARTMENT

★ EST. JAN. 11, 1851 ★

TRAINING MANUAL

HONOLULU FIRE DEPARTMENT

INTRODUCTION

Pursuant to the authority vested in the Fire Chief, this Training Manual is hereby established as the official guideline upon which all department training activities shall be based. In the administration of this department, this manual shall have equal force and effect as the Rules and Regulations and the Procedures and Manual of Operations.

Amendments and additional chapters will be periodically added to this manual. Previously issued manuals and bulletins on the same subject areas shall be superseded upon issuance of these new chapters and amendments.

Each member of the department shall be issued a copy of this manual. It shall be his duty to maintain, study and be guided by this manual. Through its proper use, improved efficiency and standardization of operational procedures will result, and a better trained and more effective firefighting work force will be developed.

Boniface K. Aiu

BONIFACE K. AIU
Fire Chief

ROPES AND KNOTS

The importance of being able to care for and handle ropes and knots cannot be over emphasized. While it would be rather ridiculous to expect a firefighter to be as adept as a sailor, who may work with ropes constantly, it should be stressed that the speed and sureness required of a firefighter when he works with these "tools" are critical because of the emergency nature of his work. The success or failure of performing rescue, hoisting indispensable equipment, or perhaps saving his own life can rest solely with his ability to handle ropes and to tie knots properly.

TYPES OF ROPE

Manila, nylon and Polypropylene ropes are generally used in the Honolulu Fire Department. Manila rope is made from the fibers of the abaca plant or wild banana plant found in the Philippine Islands. Rope made of this material has great strength and durability, with a minimum of stretch. It should be used for hoisting equipment, to operate the fly ladder on extension ladders, as a life line when wearing breathing equipment, wrecking operations, and roping off dangerous areas. Manila rope should not be used in rescue operations except to handle equipment.

Nylon rope, with its high elasticity and strength should be used where high energy absorption is needed or where shock loading is common. Nylon rope has excellent resistance to petroleum oils, common solvents, and alkalies. However, because of its slick finish, it does not present as much friction as manila rope and knots are more likely to become untied. Because of its light weight and strength, nylon rope is used extensively in rescue work.

Polypropylene is the lightest of rope materials. It floats and is unaffected by water. It resists most chemicals, and has fair resistance to abrasion and flexure. As degradation will result from continuous or excessive exposure to sunlight or ultraviolet radiation, it should be stored in a cool, dark area to deter deterioration. Breaking strength decreases as temperatures rise. For these reasons, polypropylene rope is used for water rescue and not for rappelling or firefighting.

CONSTRUCTION

Rope is constructed by twisting fibers together in a clockwise direction to make a yarn. The yarns are then twisted together in a counter-clockwise direction to make a strand and the strands are twisted together in a clockwise direction to make a rope. This reversing of the twist in every step of building a rope locks it together. The twist in one direction offers an equal resistance to the twist in the opposite direction which balances the rope and keeps it in proper shape.

It is recommended that new rope be hung from a tower several days with sufficient weight attached to stretch it before use. A rope so treated will handle much easier when put into actual service.

The size of rope is measured by giving its diameter in inches. The ropes used within the Honolulu Fire Department range from 1/4 to 3/4 inch.

In choosing a rope for a given purpose, a large margin of safety should be used. As an example, to hoist a weight of 500 pounds, do not select a rope with a maximum breaking strength of 500 pounds but rather one with about seven times this amount of breaking strength or a breaking strength of 3500 pounds.

STRENGTH OF MANILA ROPE IN POUNDS

Diameter	Safe Working Strength	Breaking Strength
1/4 inch	55	390
1/2 inch	225	1575
3/4 inch	505	3540
1 inch	900	6300

Note: For nylon rope, multiply the breaking strength by two.

To find the approximate safe working strength (SWS) of a manila rope, use the following formula:

C^2 X 100 lbs. (Circumference squared times 100 pounds)

To find the circumference of a rope: D X 3 (Diameter X 3)

Example:

To find the SWS of 1/4 inch manila rope.

1/4 = .25 C= .25 X 3
C- .75
SWS = C^2 X 100 lbs.
SWS = .75 X .75 X 100
SWS = .5625 X 100
SWS = 56.25 or 56 lbs.

CARE OF ROPE

Rope should not be stored in compartments that are damp or with sharp edged tools. They should always be coiled and ready for use. If a rope must be washed, wash in clear, fresh water to remove salt, sand, grit or ashes. Dry thoroughly prior to storage. Drying is best accomplished by hanging the rope in loose, well-separated loops in a well-ventilated area out of the sun.

Avoid dragging rope over rough surfaces. It should be drawn over a hose roller when hoisting equipment over a roof edge or parapet. Do not store near acid fumes, storage batteries which give off sulfuric acid fumes or other chemicals, such as paint, oils or petroleum products. Do not store rope directly on cement floors. Place the rope on a wooden platform to allow ventilation.

Do not allow tension to be applied to a rope when there is a kink or sharp bend in it. This will break or weaken fibers and this will reduce the breaking strength of the rope. DON'T OVERLOAD A ROPE. If an object weighting 100 pounds must be hoisted, then a rope with a minimum breaking strength of 700 pounds should be used. In this case, a rope of 3/8 inch diameter would be the minimum size.

Rope should be inspected after each use and at least every 6 months if not in use. Rope should be checked through the entire length internally and externally. For external inspection, look for broken fiber or cuts. Feel if rope is extremely soft or smaller in circumference than normal. Check for rot or chemical burns. To check for internal damage, separate strands at 3 foot intervals and examine for broken firbers, mold, mildew, or a change in color. A fine powder indicates the presence of grit. Rope should be replaced when inspection indicates it has been contaminated by chemicals, acids or petroleum products; there is physical damage; fibers broken or worn, rot or a variation in size and shape of strands.

Exposure and wear are important factors in determining the strength of rope. A liberal allowance should be made for both when estimating the strength of old rope for any purpose.

COMMON TERMS USED WHEN DEALING WITH ROPES

1.	Bending:	Tying
2.	Bight:	A U-shaped bend in a piece of slack rope.
3.	Bitter end:	The end or tip of a rope.
4.	Faking down:	Laying rope down in long, flat, figure eight shaped bights.
5.	Marlin:	The twine used to "seize" or "whip" rope ends.
6.	Seizing:	The same as whipping. In addition, it means to lash two ropes together, such as the bitter end to the standing part of the rope.
7.	Splice:	To unite by interweaving the strands. Also the name of that union.
8.	Whipping:	A method of wrapping twine around the bitter end of a rope to prevent it from becoming unlaid. Sometimes known as "seizing."
9.	Working line:	All of that portion of the rope which is not used up in tying knots at the ends. Also known as the "standing part."

KNOTS - BIGHTS - BENDS - HITCHES

The knots, bights, bends, and hitches in common use are:

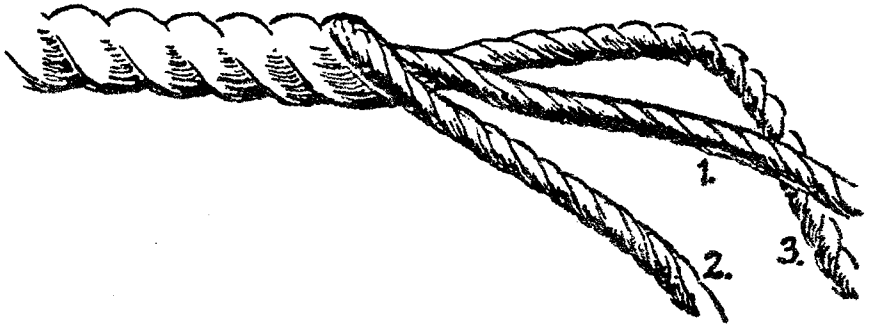
Bowline
Running Bowline
Bowline on a Bight
Half Hitch
Clove Hitch
Timber Hitch
Beckett Bend
Running Double Loope
Slip Knot
Square Knot
Hose Roller Knot

Before proceeding to the knot tying, it is important to know the effect of a knot or knots on a rope. Rope has its maximum strength when strain is applied evenly to all fibers. When a rope is tied, the weakest part of the rope is at the knot. The shorter the bend, the less strength in the rope.

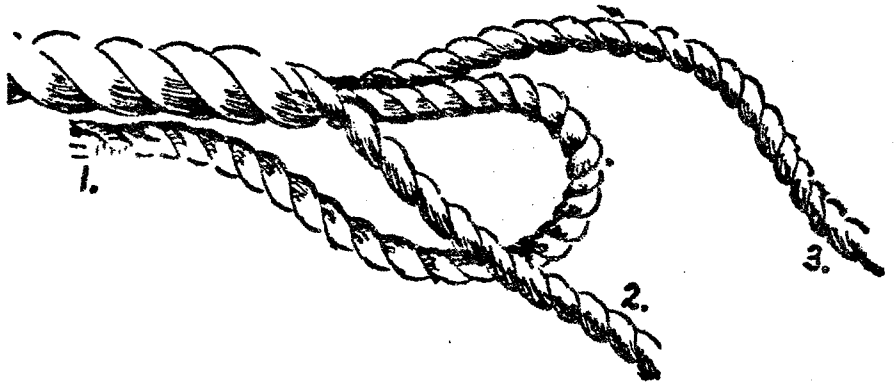
Example: A square knot will weaken a rope by 55%; a bowline, 50%; a clove hitch, 25%; and a short splice by 15%. (Safety Engineering Standards, 1976)

Knots, bights, bends, and hitches are used singly or in combination to form all the various ties used in the Honolulu Fire Department. The following information and illustrations should clarify their application to equipment that is to be hoisted or lowered.

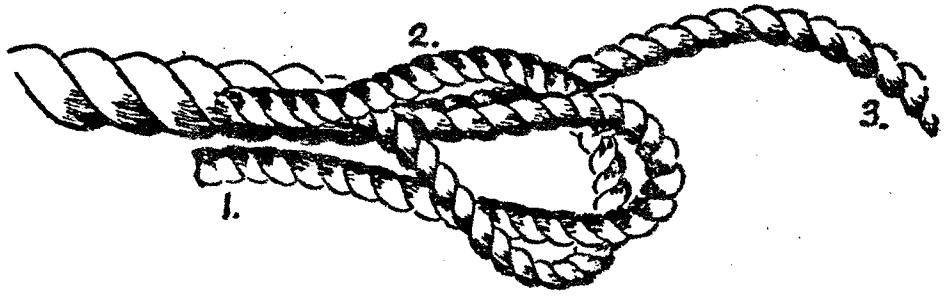
BACK SPLICE



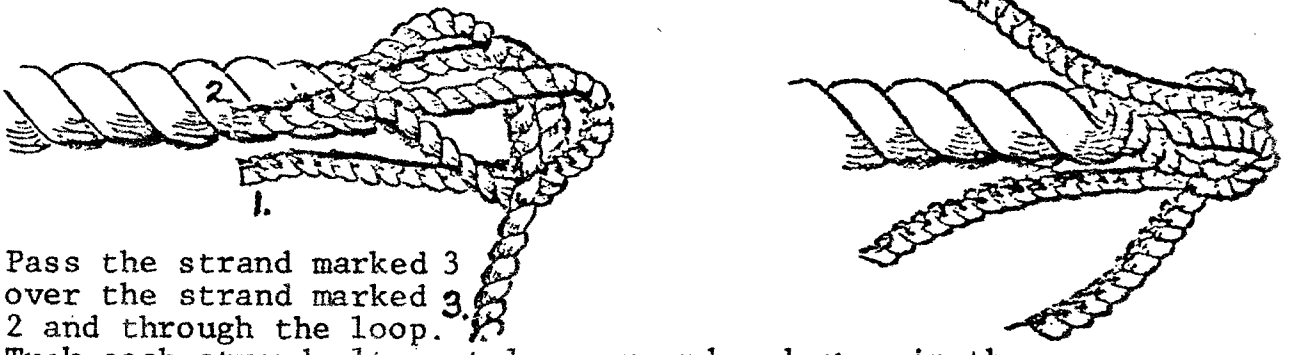
Unravel a short portion at the end of the rope. The desired length of the back splice will dictate how much to unravel.



Take the middle strand marked "1" and form a loop.



Take the strand marked "2" and bring it around to the left between the loop and the strand marked "3".



Pass the strand marked 3 over the strand marked 2 and through the loop.

Tuck each strand alternately over and under as in the eye splice, working against the lay of the rope. Pound and roll the splice. Cut off short strands close to the rope.

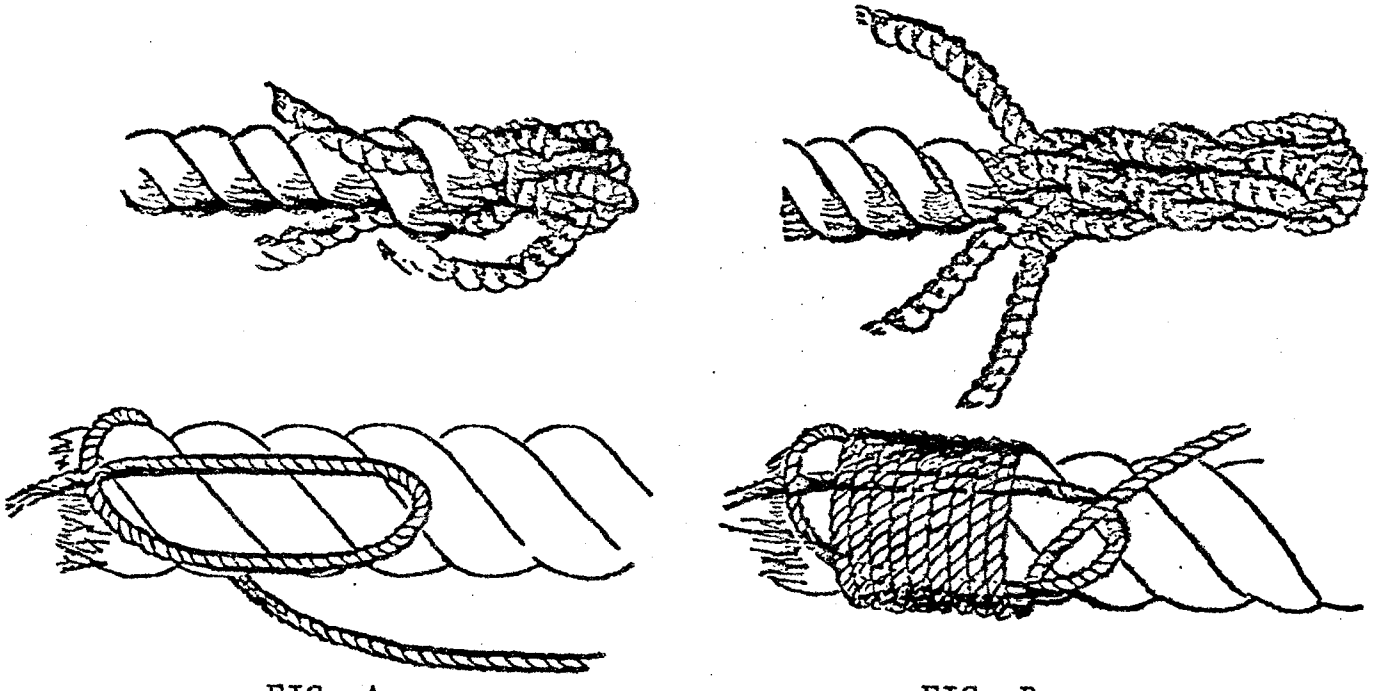


FIG. A

FIG. B

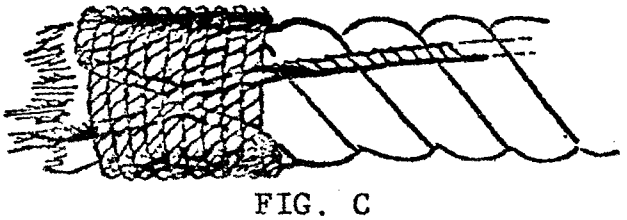
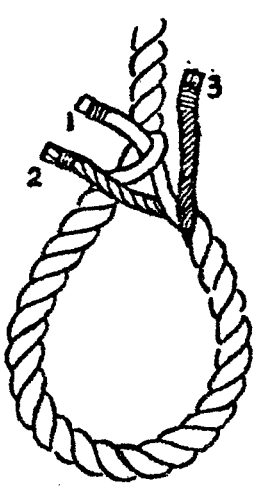


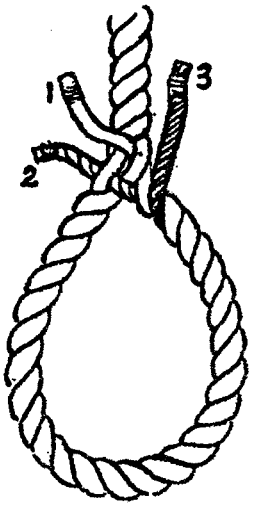
FIG. C

WHIPPING

Place the end of the yarn at the end of the rope and form a loop. (Fig. A). Then wind the yarn tightly around both the loop and the rope. Continue to wind for a distance equal to the diameter of the rope being whipped. Finish by putting the winding end through the loop (Fig. B). Pull the end tight until the loop is drawn back out of sight. (Fig. C). Snip off the ends.

EYE SPLICE

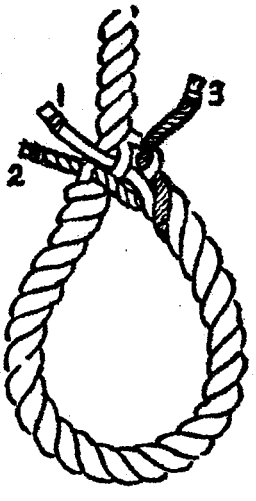


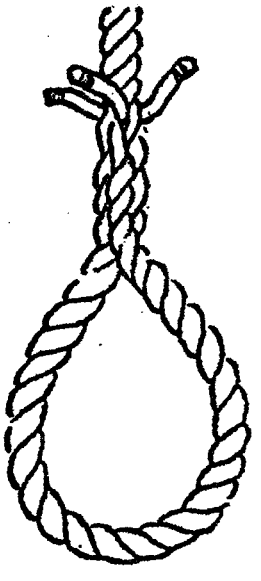


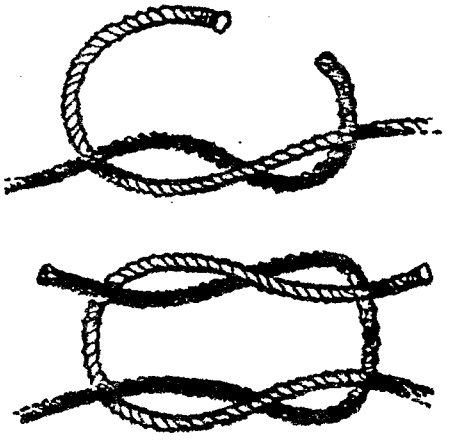
Unravel a short portion at the end of the rope and form the desired size loop. Take the middle strand, #1 and tuck through any strand of the standing part of the rope.

Take the next strand marked #2 and pass it over the strand under which #1 is tucked and then pass it under the adjacent strand of the standing part.

Take the remaining strand marked #3 and tuck it through the last strand of the standing part of the rope on the other side. Tuck each strand alternately over and under working against the lay of the rope. Taper off by halving the yarns on the last two tucks, pound and roll, then cut off remaining strands close to the rope.

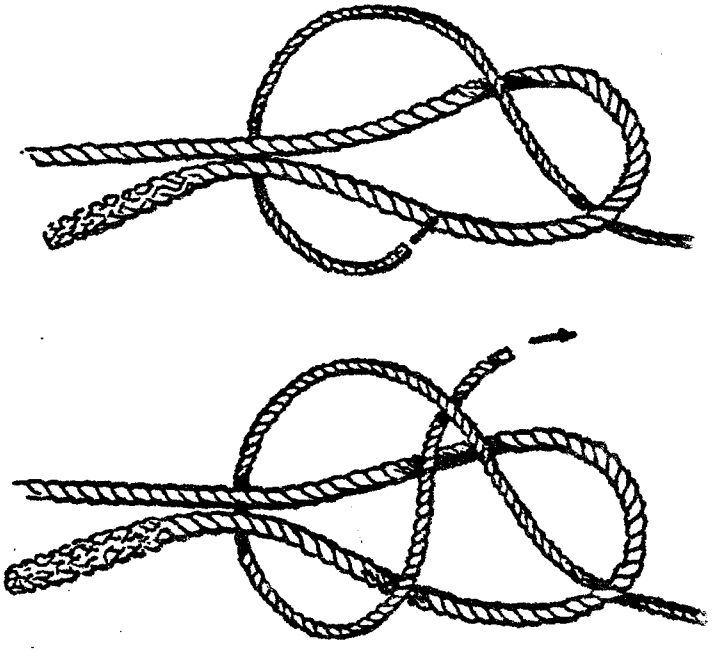






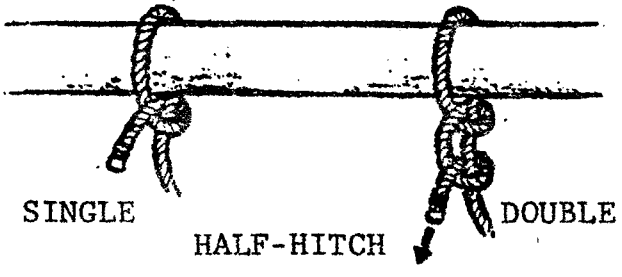
SQUARE KNOT

Used to join two ropes of equal size.

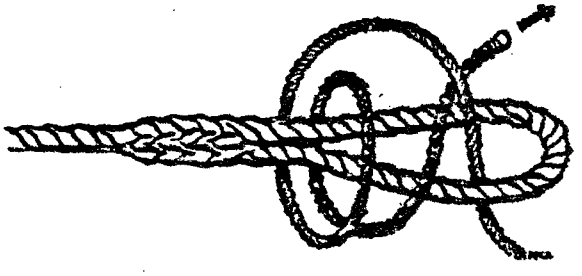


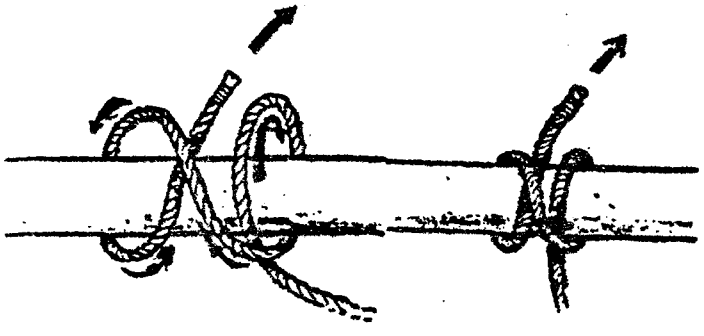
SINGLE BECKETT BEND

Used to join two ropes of unequal size.



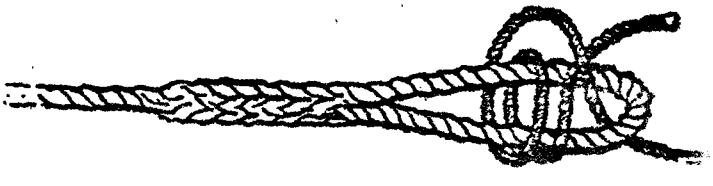
Used in connection with Clove hitch in raising and lowering equipment.





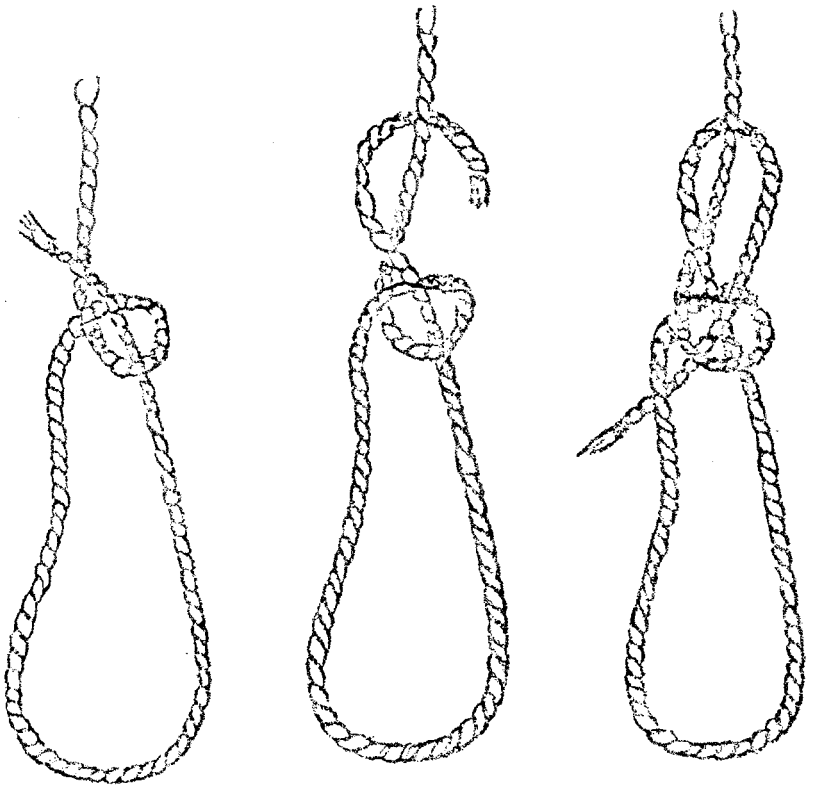
CLOVE HITCH

Used extensively in raising and lowering equipment



DOUBLE BECKETT BEND

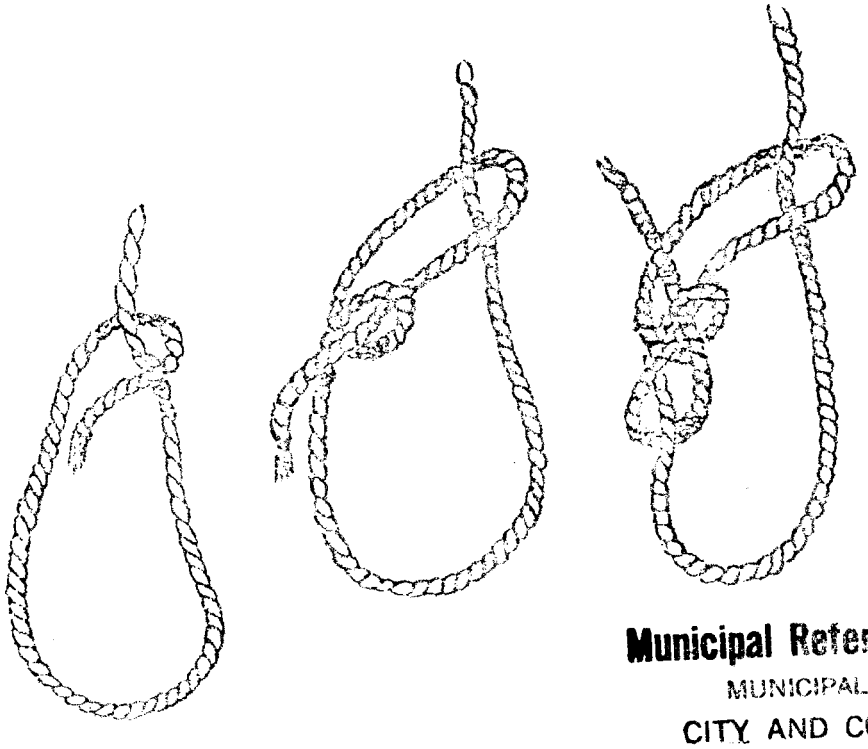
Used where more safety margin is required.



BOWLINE

Used for hoisting and lowering ladders, hitching and whenever a loop is desired at the end of a rope.

Note: The bitter end of a finished knot or hitch should be at least 8" long.

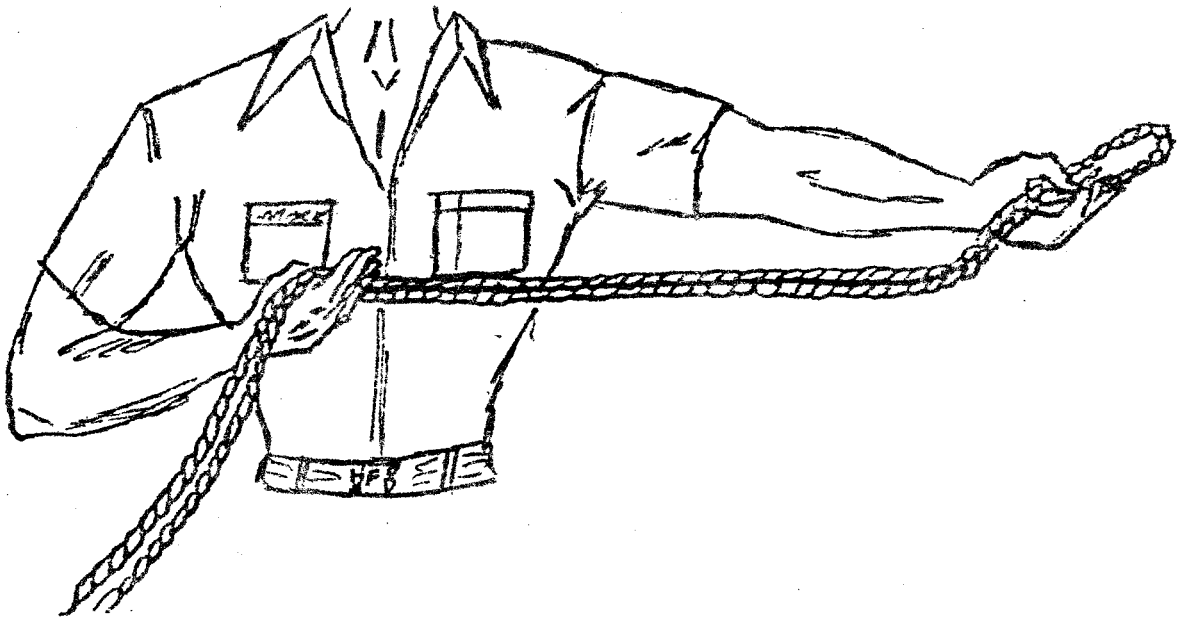


RUNNING BOWLINE

Used for hoisting or lowering charged hose and securing hard suction when at draft.

Take a life line, stretch it out at arms length with 6 to 8 inches of the bitter end hanging from left hand.

Crimp the standing end with the right hand. Place crimp in left hand with approximately 6 inches hanging loose.



Extend left hand and place right hand at chest holding double standing line. This will become the reference point for tying a bowline on a bight.

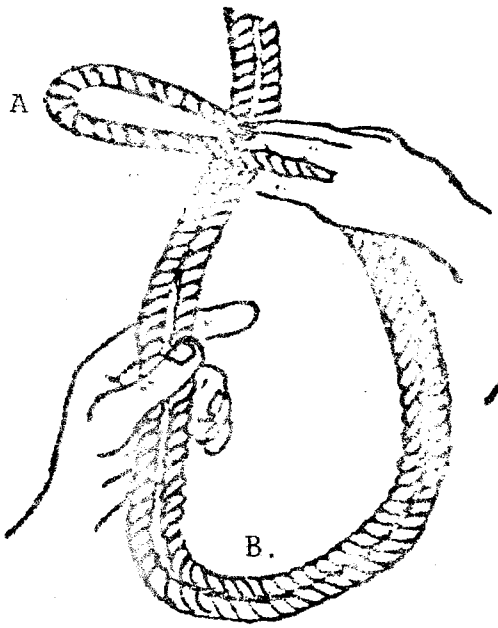


Fig. 1

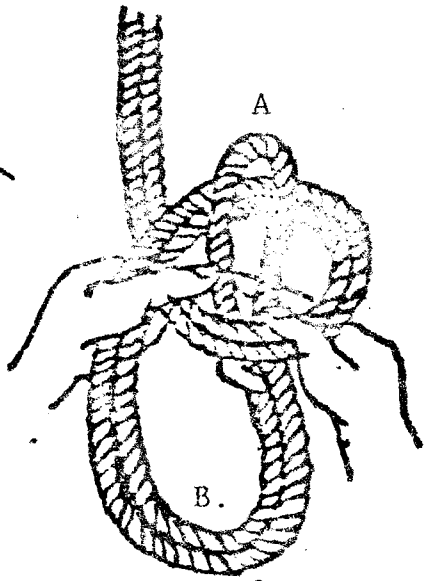


Fig. 2

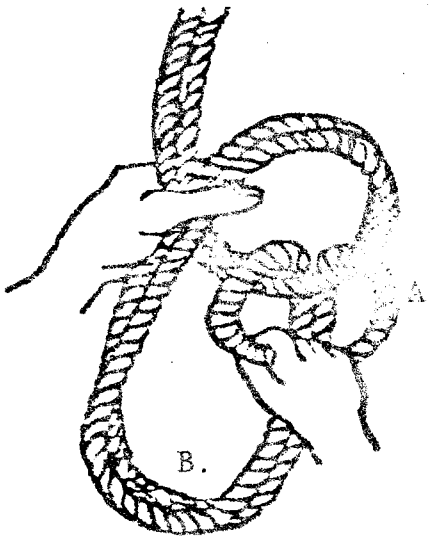


Fig. 3

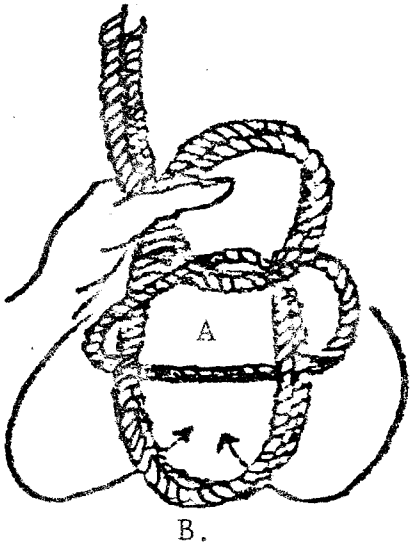


Fig. 4

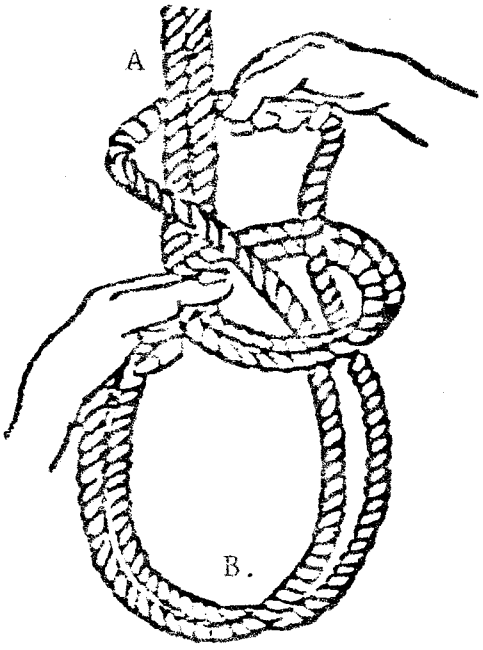


Fig. 5

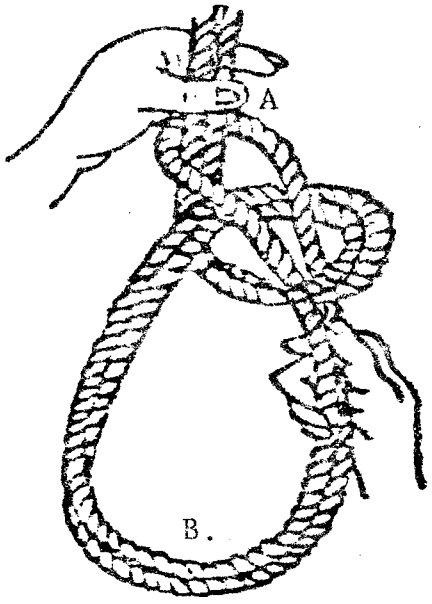
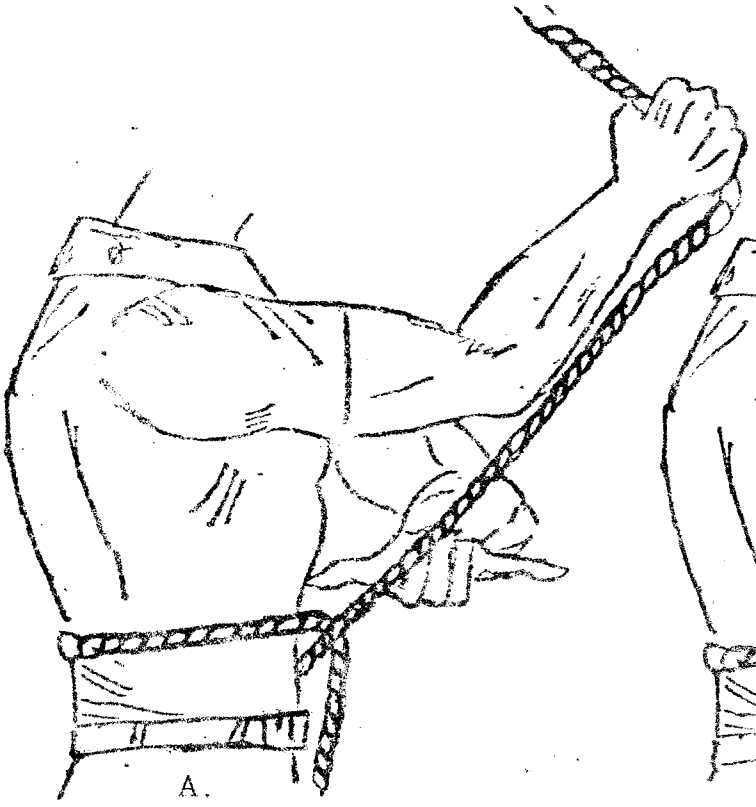


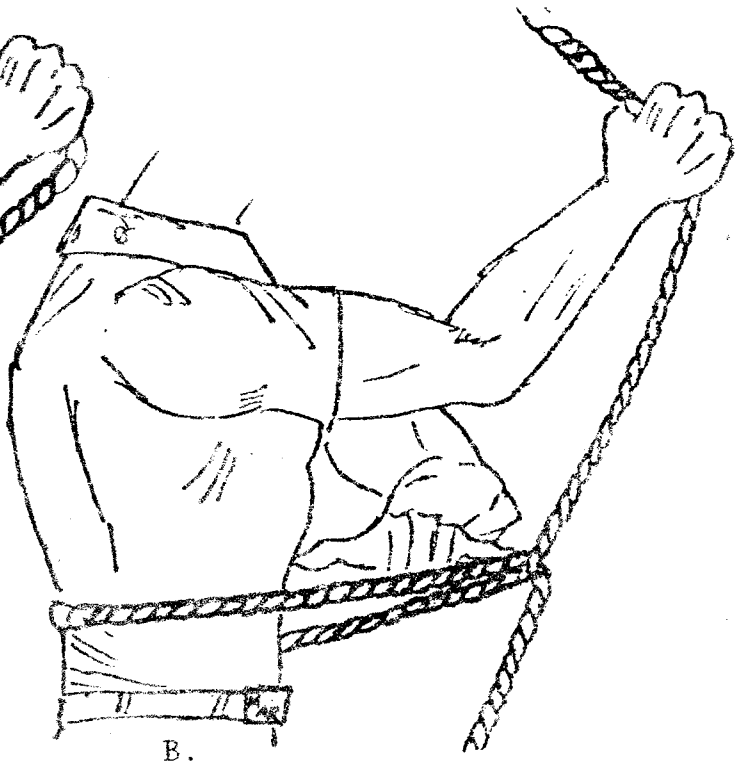
Fig. 6

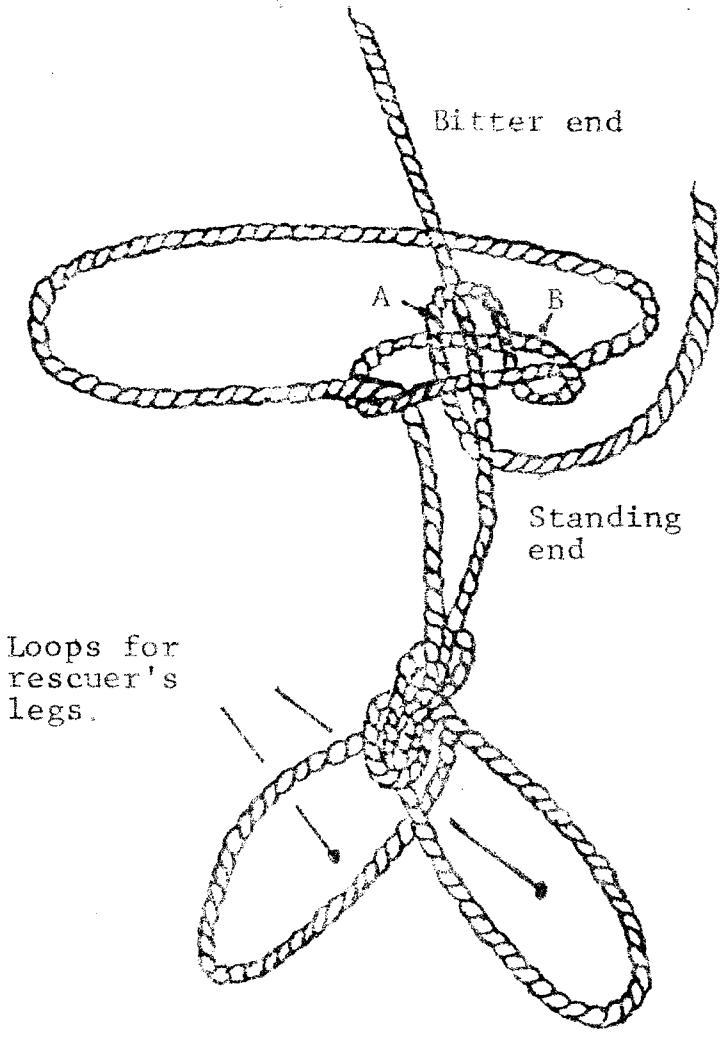
Fig. 1 & 2. Lay the 6 inch bight (A) across the two ropes about 3 inches above left hand. This forms a double roped circle which will become the leg loops. Place your right thumb under the two ropes and hold securely. With the left hand maintaining its grip, the right hand will "roll" the bight (A) down, around, and up through the inside of the circle (B).

Fig. 3 & 4. With the right hand, take the bight (A) and pull it down and over the circle (B).

Fig. 5 & 6. Lift bight (A) up until it is over standing part of rope. Pull loops (B) until bight (A) is snug. These loops are for your legs.

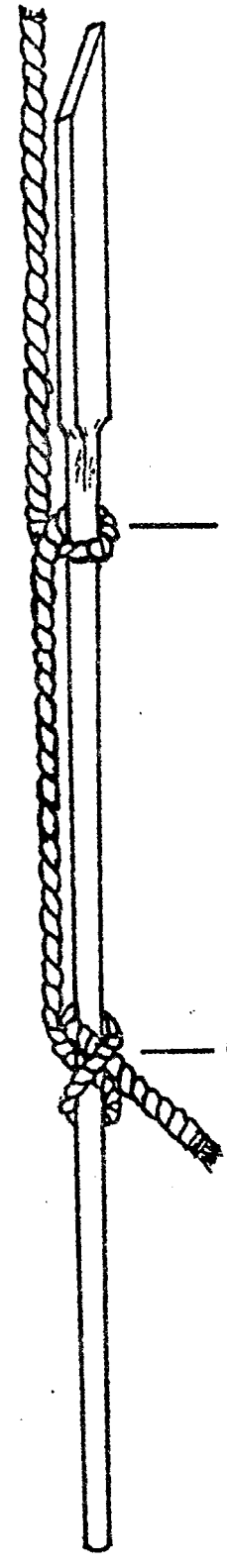




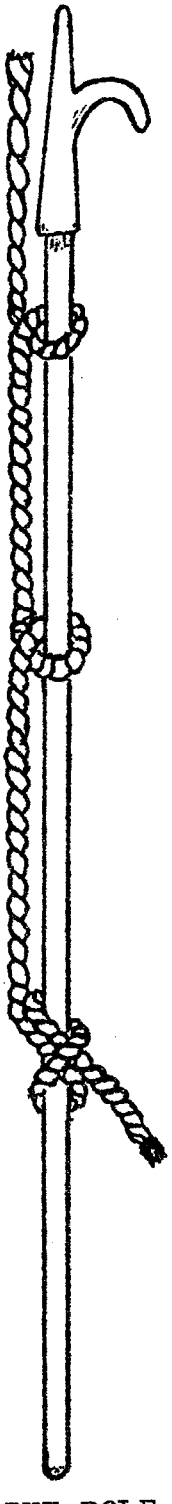


To make this a rescue knot, make a half hitch around the waist of the rescuer with the standing part of the rope coming from under the left arm. Tighten the half hitch around the waist, then take one full hand span of rope away from the waist (A). This will be your reference point. Now move tightened half hitch to this reference point (B). Hold knot securely with your right hand.

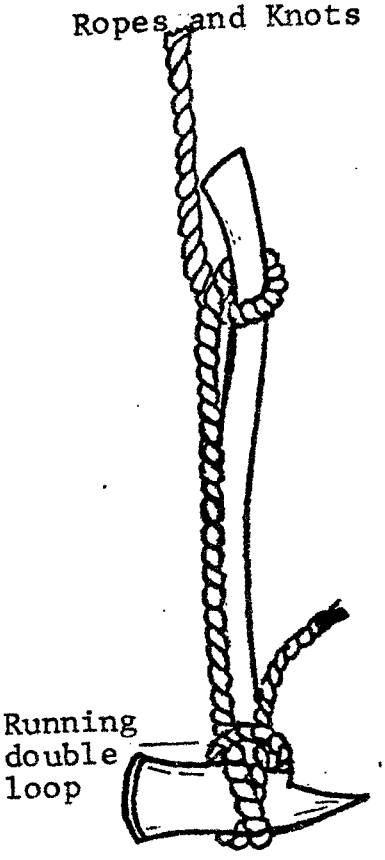
Take the standing end with left hand and go under the half hitch and back into loop that is formed (B). Take the bitter end and insert into loop (A). Drop bitter end. Pull the standing end up until the loops roll into a bowline. The rope around the chest should be loose. If it is tight, start the knot over again.



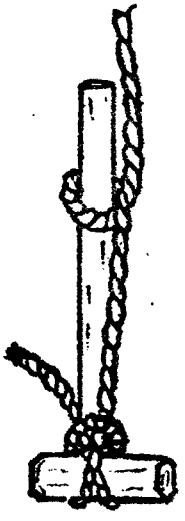
CROW BAR



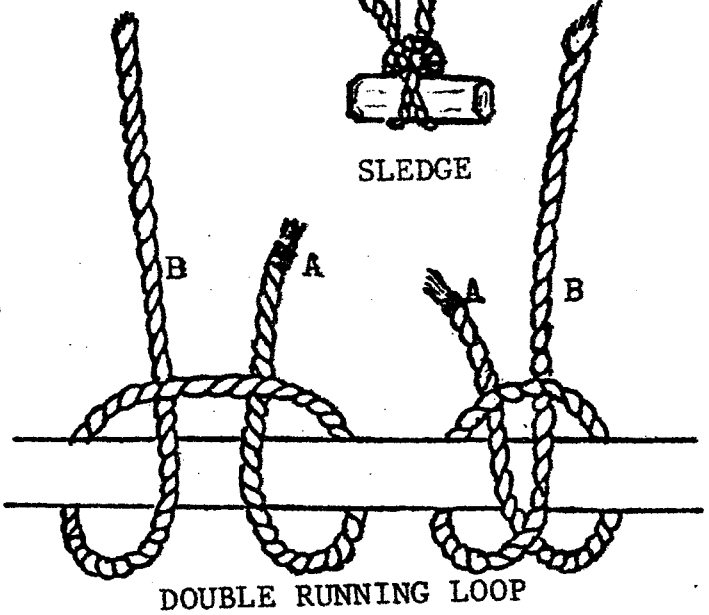
PIKE POLE



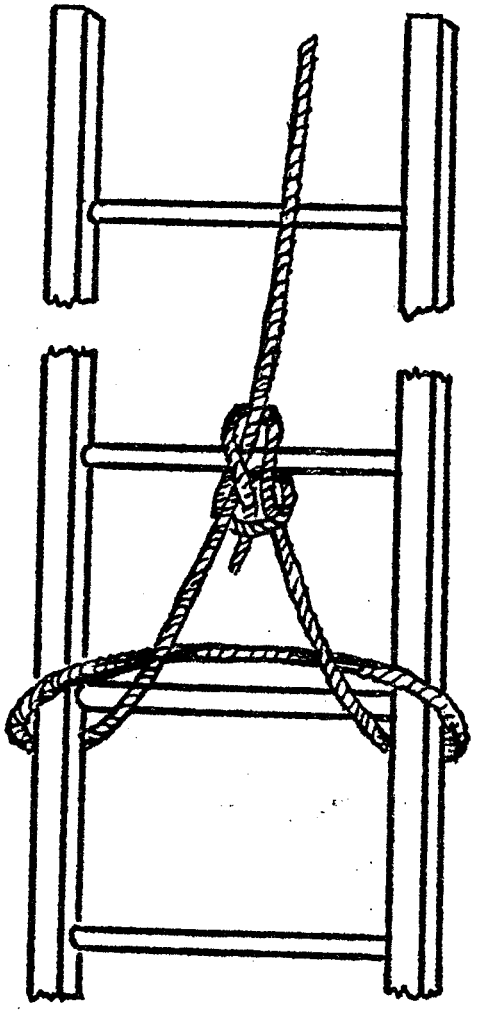
AXE



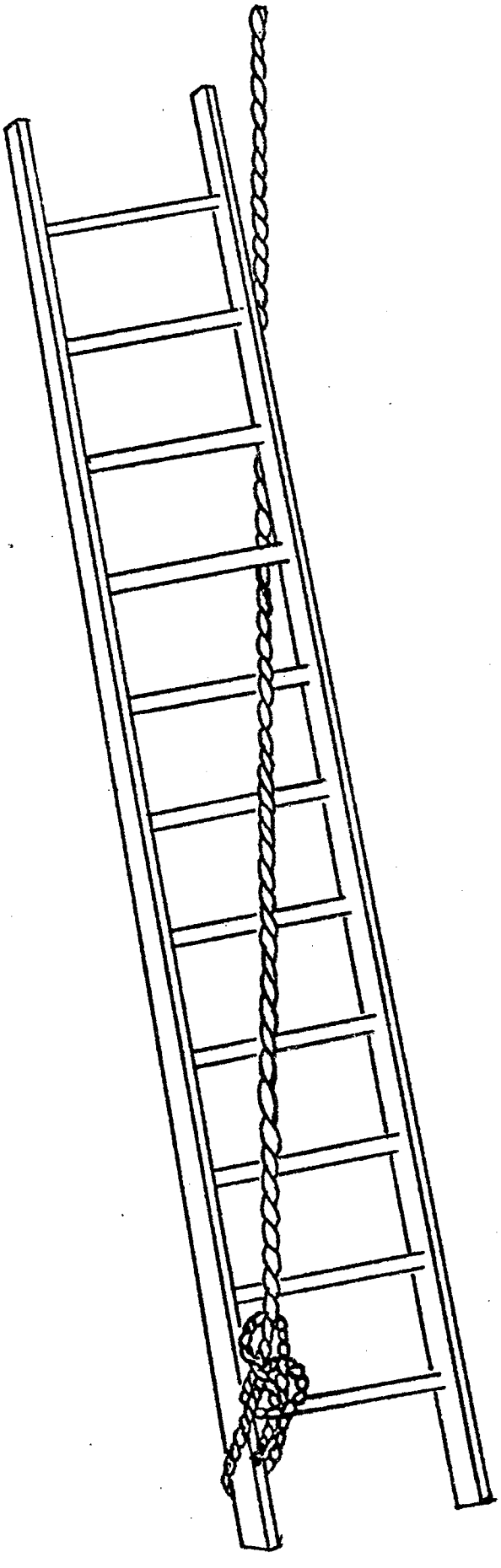
SLEDGE

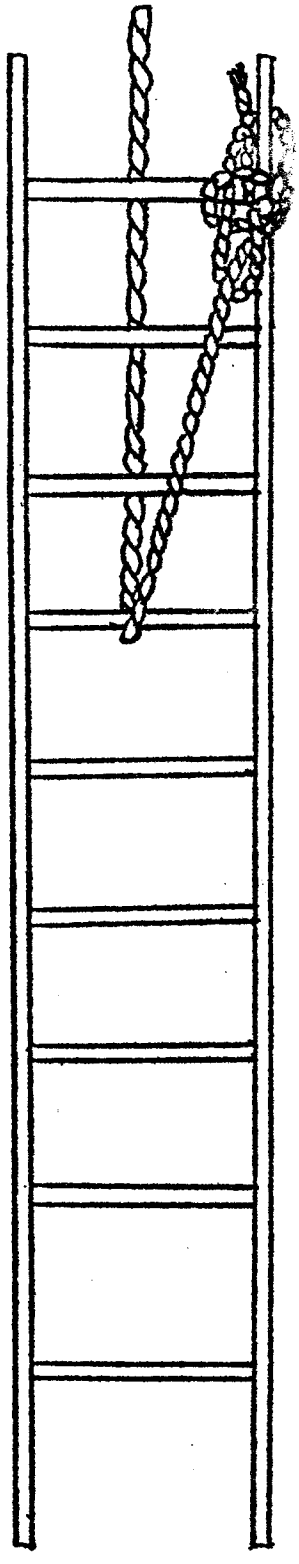


DOUBLE RUNNING LOOP

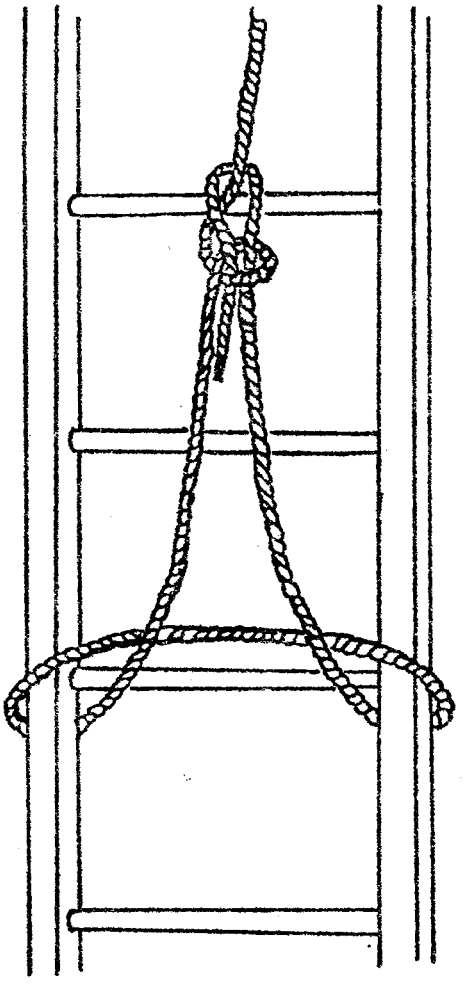


In hoisting straight beam ladders of any size, the same procedure is followed as shown above. Place the rope through the ladder below the proper rung. (To find the proper rung, divide the length of the ladder by 5 and multiply by 2.) Bring rope around the outside of near beam, thus forming a half hitch. Cross rope over ladder, around opposite beam and bring rope through ladder below the same rung as the first half hitch. Both pull ropes are under the same rung and over the top of the cross rope. Finish the tie with a bowline knot secured not more than two rungs above the half hitches.

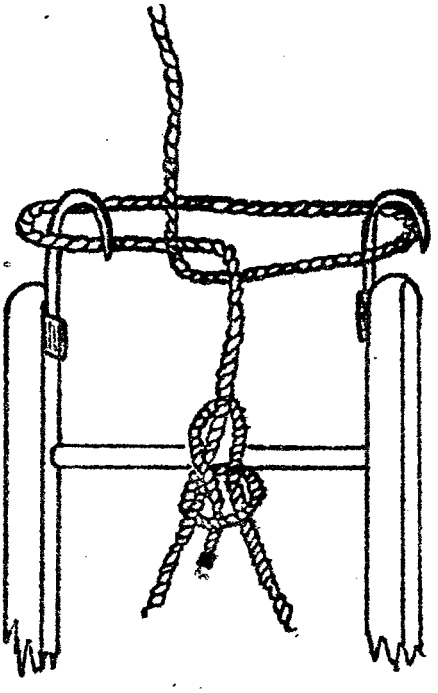




Alternate method for hoisting straight and roof ladders.

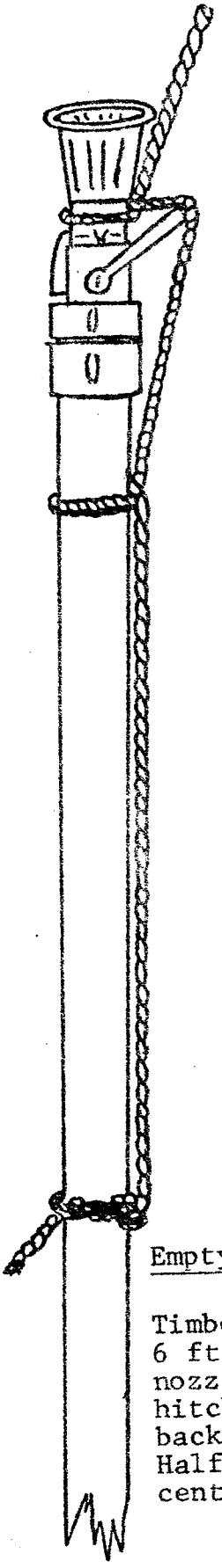


HOISTING ROOF LADDER



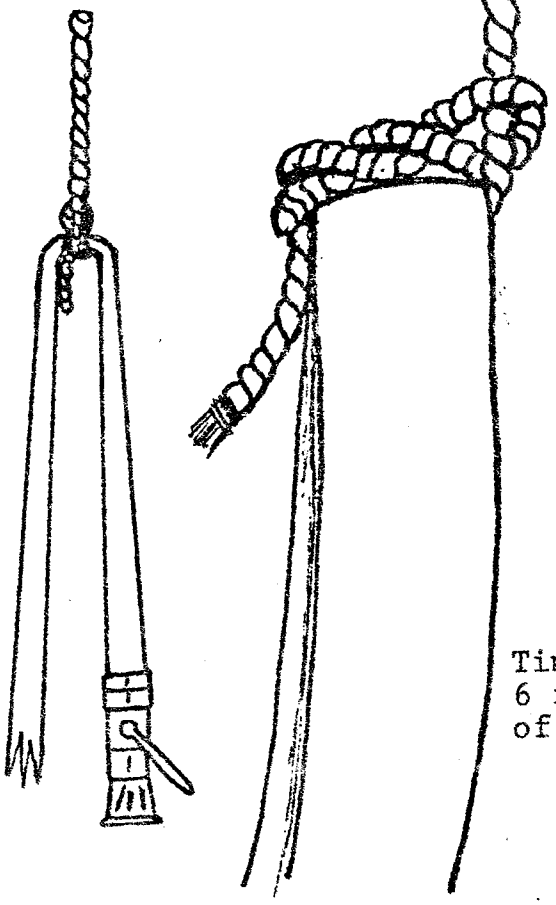
In hoisting roof ladders of any size, the following procedures should be followed:

Place the rope through the ladder below the third rung and around the nearest beam, thus forming a half hitch. Cross over ladder, around the opposite beam and bring the rope through ladder, below third rung. Finish the tie with a bowline knot at the top rung and a half hitch around both hooks.



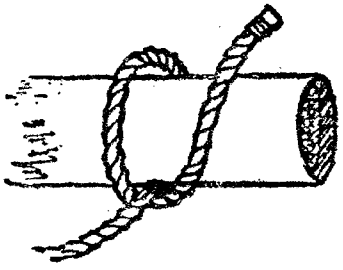
Empty Line Down

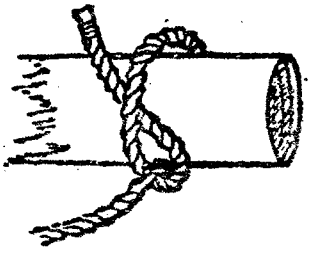
Timber hitch 6 ft. back of nozzle. Half-hitch 6 in. back of nozzle. Half-hitch around center of nozzle.

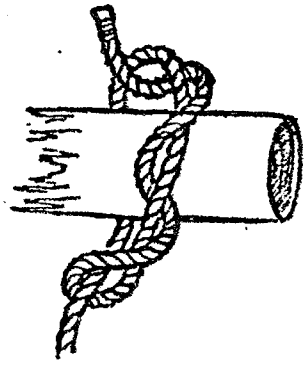


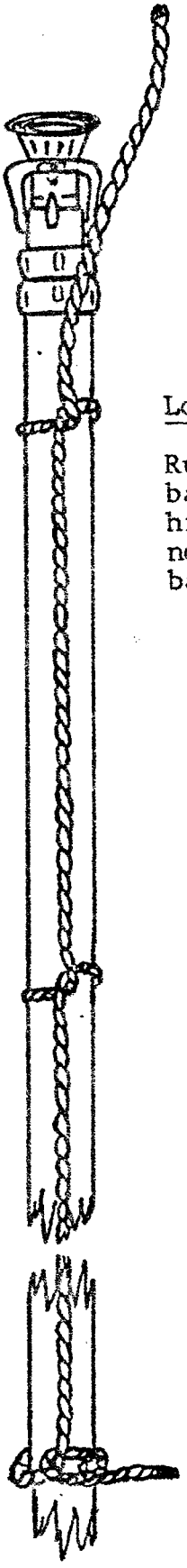
Timber hitch 6 feet back of nozzle.

Empty Line Up







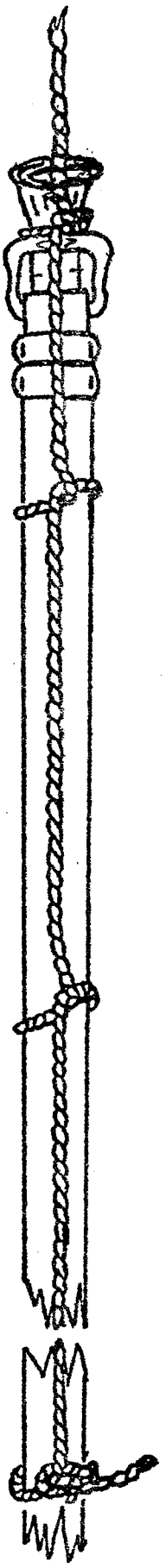


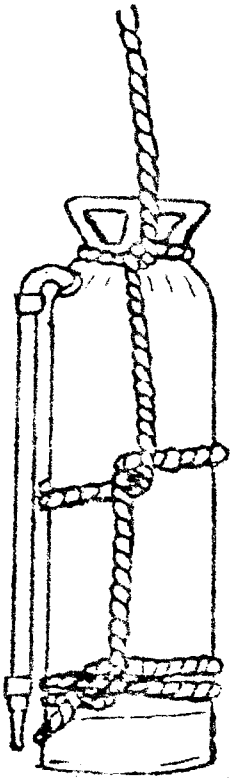
Loaded Line Up

Running bowline 15 ft. back of nozzle. Half-hitch 7-1/2 ft. back of nozzle. Half-hitch 6 in. back of nozzle.

Loaded Line Down

Running bowline 15 ft. back of nozzle. Half-hitch 7-1/2 ft. back of nozzle. Half hitch 6 in. back of nozzle. Half hitch around center of nozzle tip.

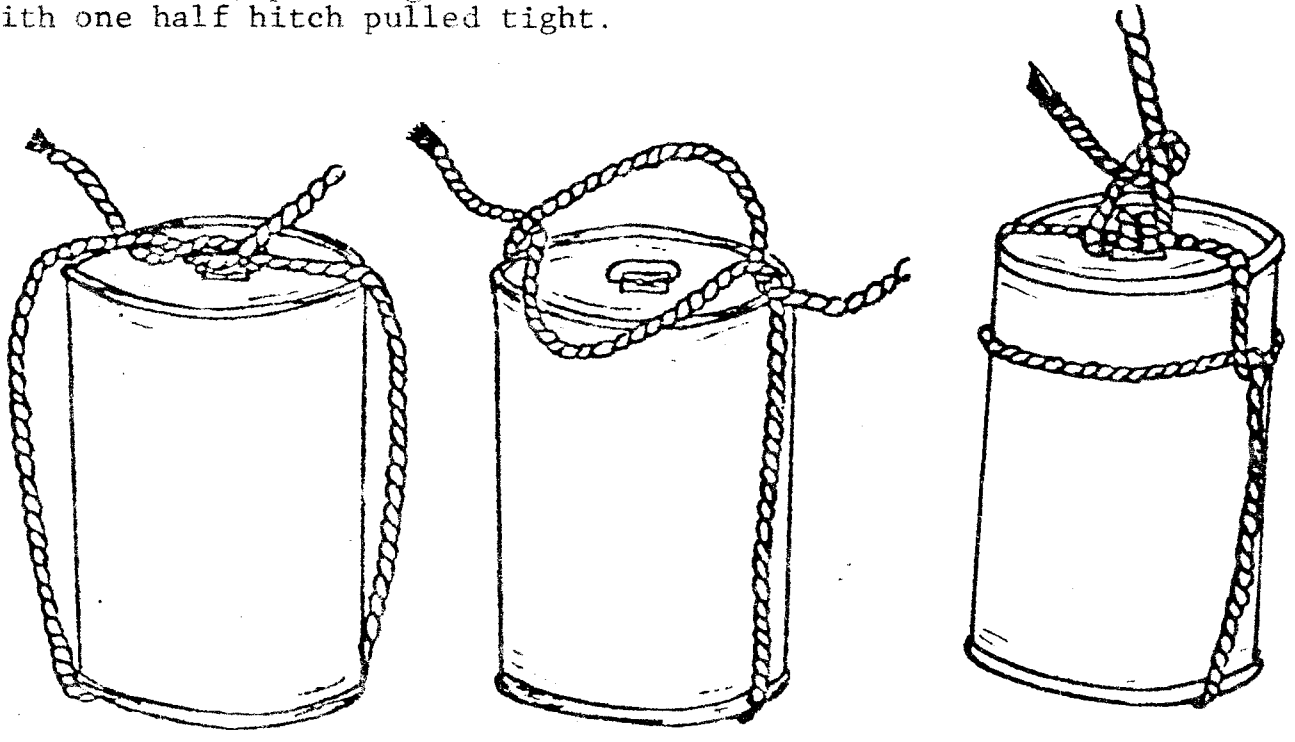


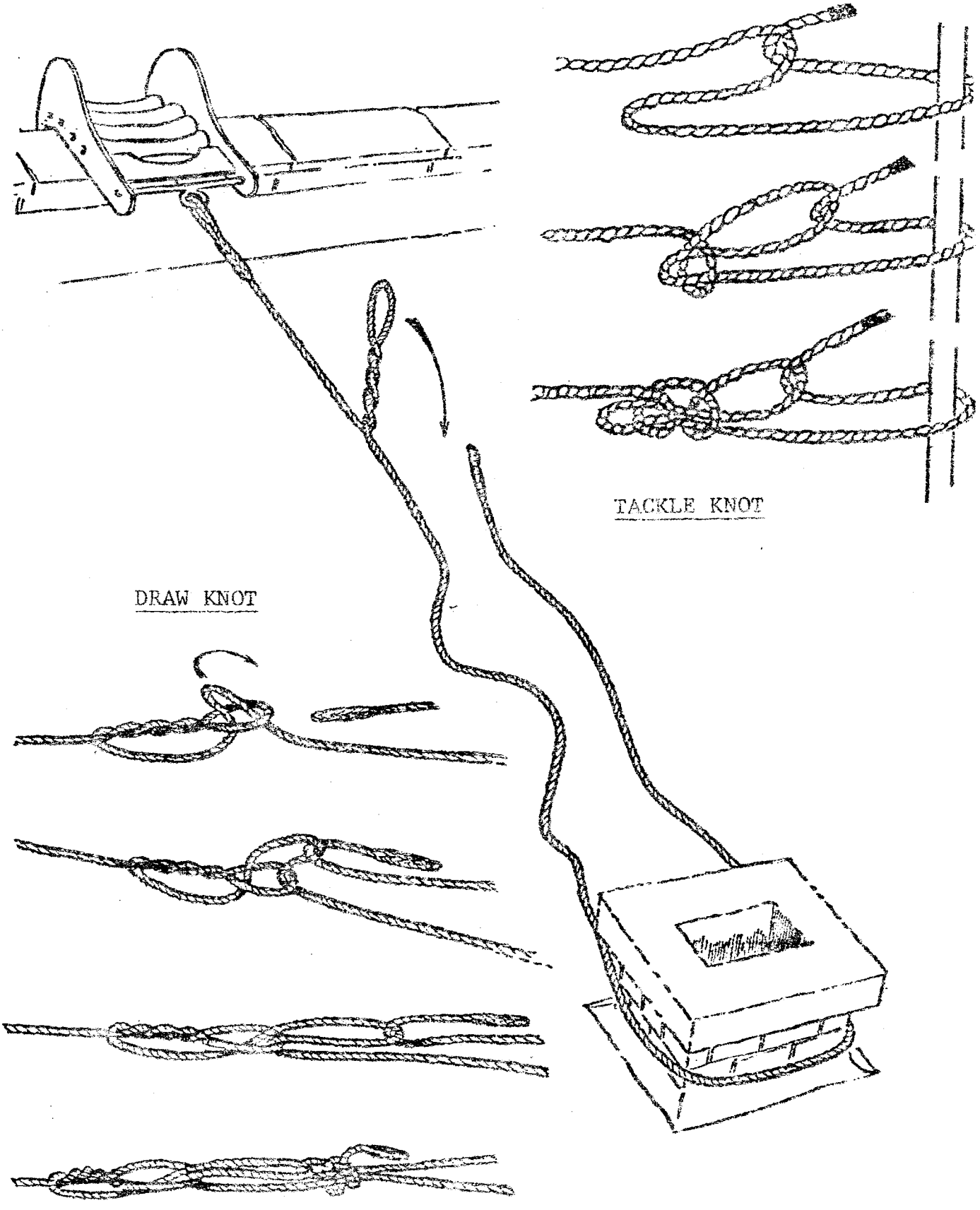


To hoist a fire extinguisher, use a Clove hitch around the bottom with Half-hitches midway and at the top of the extinguisher.

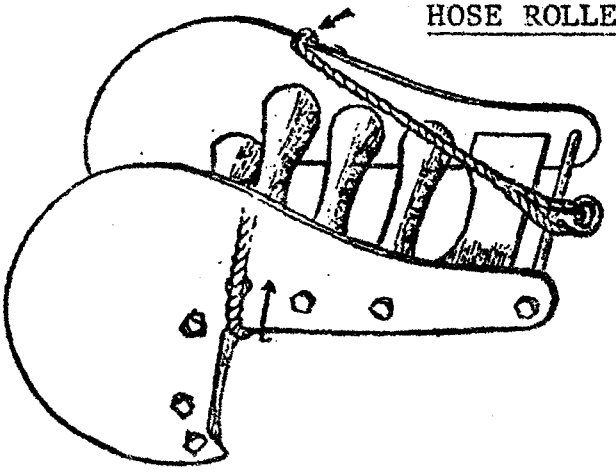
BARREL HITCH

Stretch rope out straight on the ground and set can at a distance from the bitter end equal to twice the can's height. Tie an overhand knot so the rope will drop around the circumference of can about one third of the way down. Bring the bitter end and the working line to the top and fasten them together with a double overhand knot, pull tight until knot is centered over can. Finish with one half hitch pulled tight.



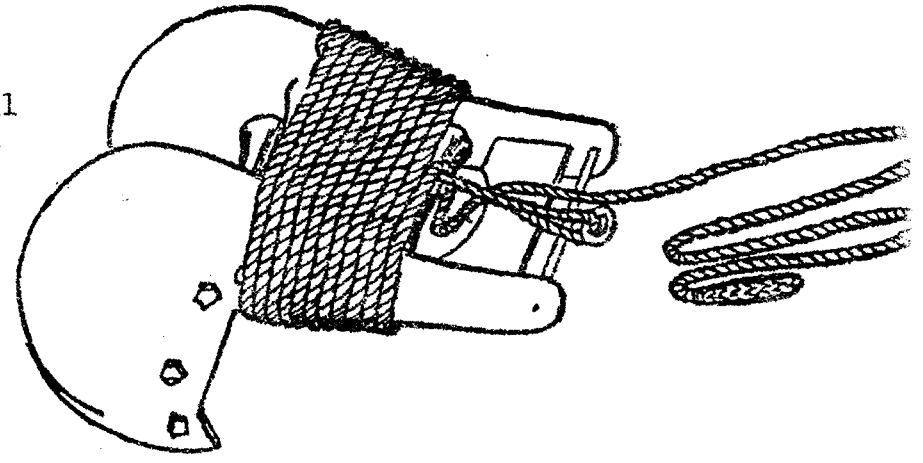

TACKLE KNOT
DRAW KNOT

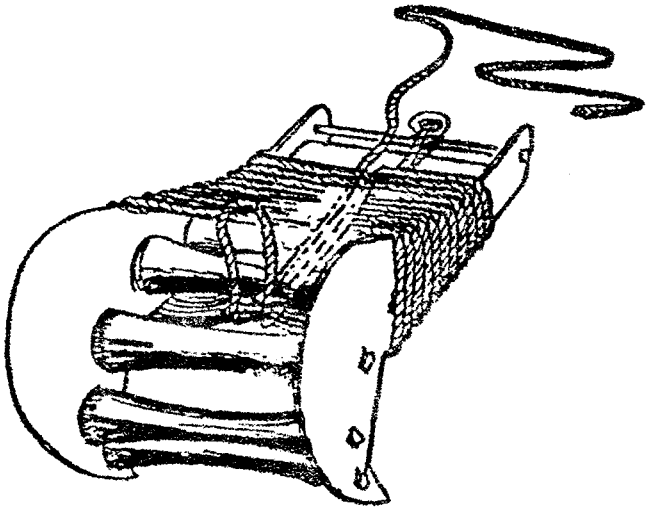
HOSE ROLLER COIL



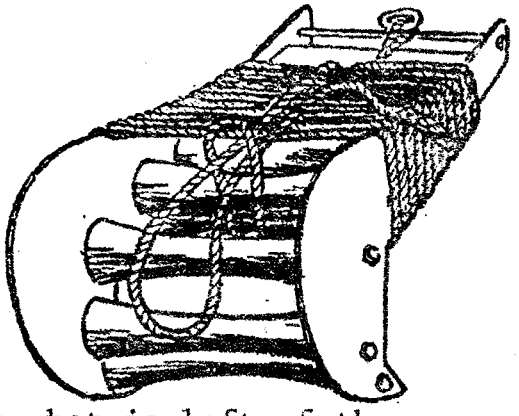
Begin by placing the rope on the right side of roller, then make wrap around. 40 ft. of 1/2 inch rope should be attached to the eye of the hose roller.

Continue wrapping until 10-1/2 wraps have been completed. Tuck the tail of rope through the roller.

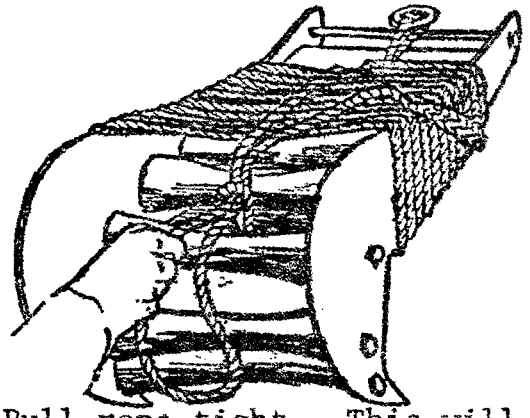




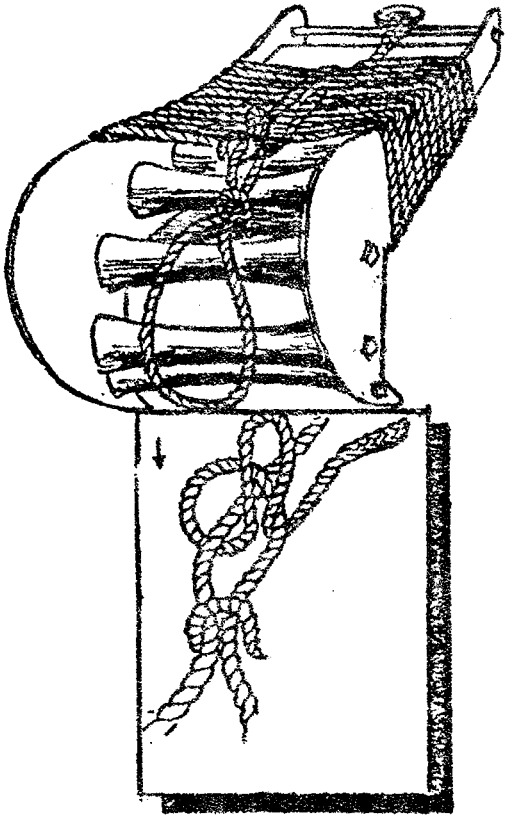
After making the tuck, continue with the rope under the bottom wraps and out between the two rollers closest to the wraps. This forms a small loop.



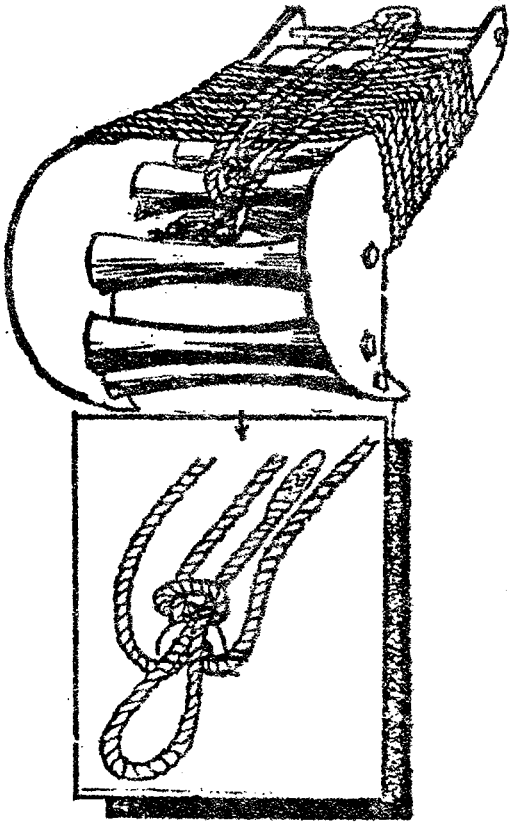
Double what is left of the tail and bring it over the the top of the wraps and through the small loop.



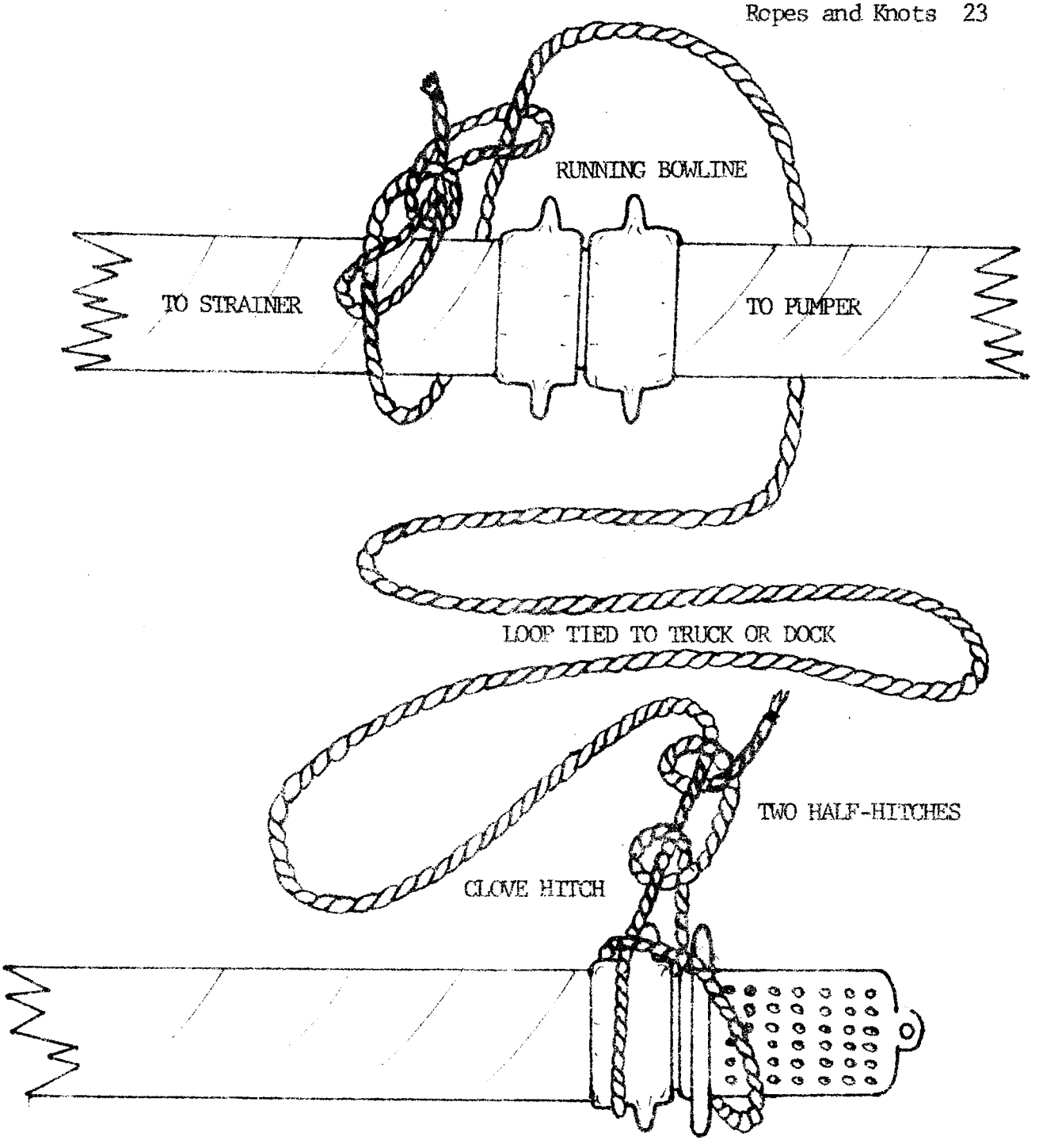
Pull rope tight. This will snug the small loop against the roller and form a large loop which will become the carrying sling.



With excess rope, make a slip knot, as shown above. Place ends of slip knot between the wraps.

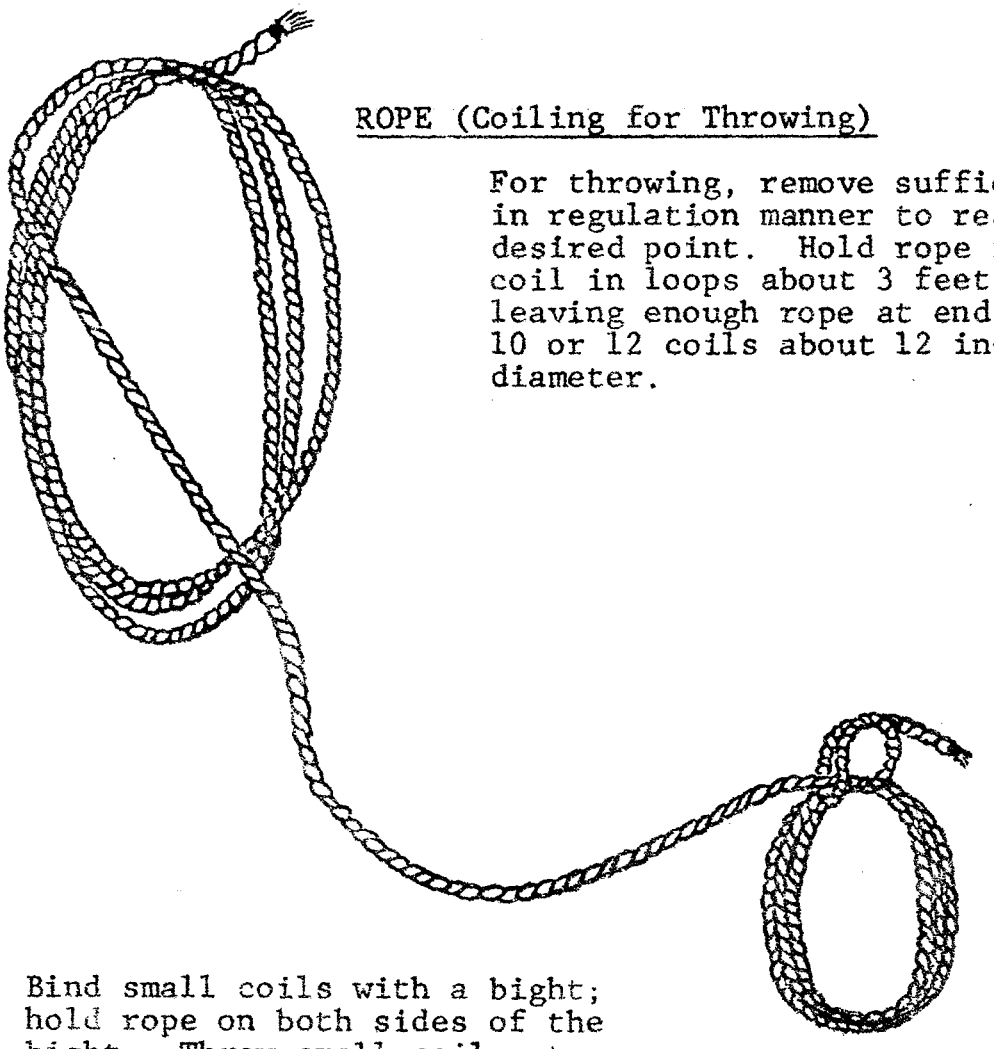


Bring the carrying sling over the metal eye. This should be tight. Twist rope sling, if necessary, to tighten.



SECURING HARD SUCTIONS WHILE AT DRAFT

Tie a clove hitch at the coupling with the strainer attached. The hitch is to be separated on each side of the coupling and strainer lugs. With the other end of the rope, tie a running bowline below first coupling on the same length that the strainer is attached. Secure loop of rope to pumper or any convenient place on the dock. Securing the hard suction as above relieves strain from couplings and facilitates removal from the water.

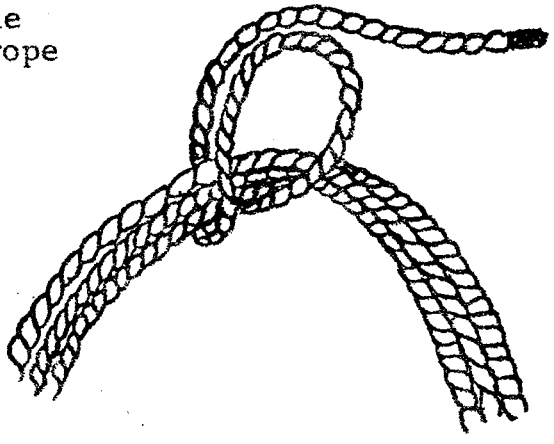


ROPE (Coiling for Throwing)

For throwing, remove sufficient rope in regulation manner to reach desired point. Hold rope in hand; coil in loops about 3 feet in diameter, leaving enough rope at end to make 10 or 12 coils about 12 inches in diameter.

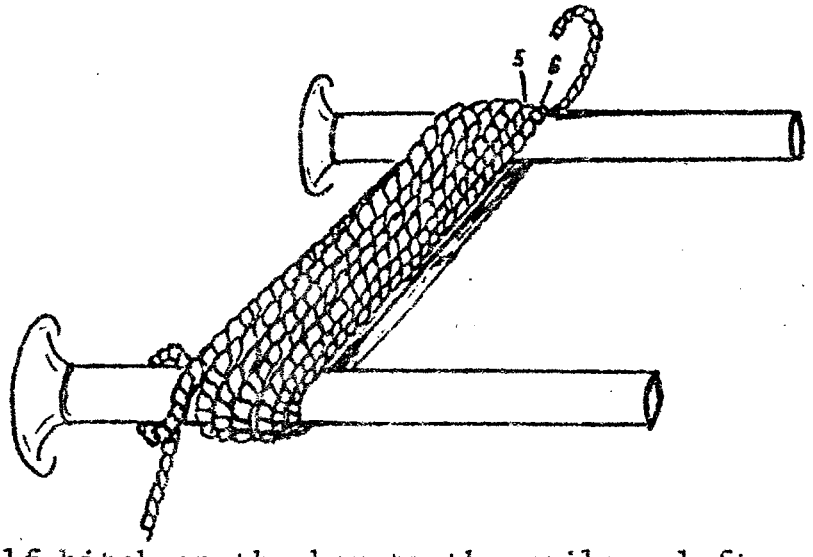
Bind small coils with a bight; hold rope on both sides of the bight. Throw small coils at the objective, allowing the large coils to pay off other hand; retain hold on rope.

In this method of throwing a rope, the small coils supply the weight necessary to carry the rope to a given point.

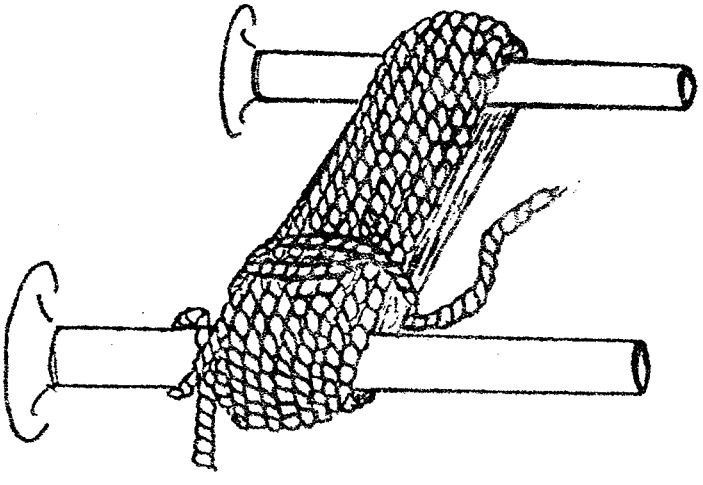


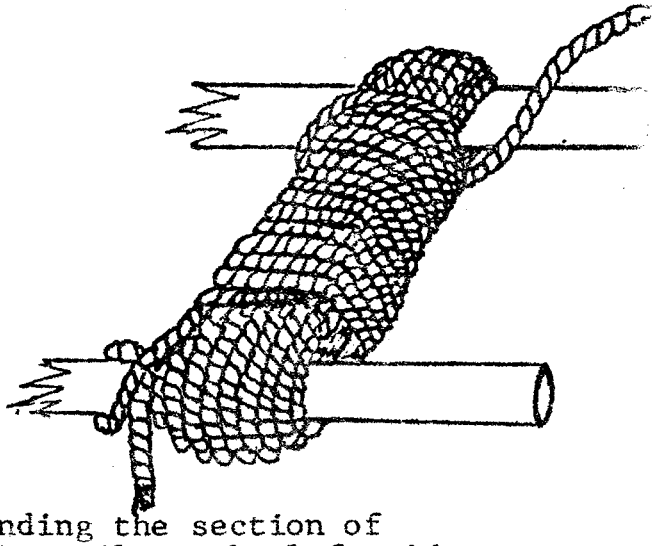
COILING A ROPE

Coiling 150 feet of 1-inch or 3/4 inch rope.

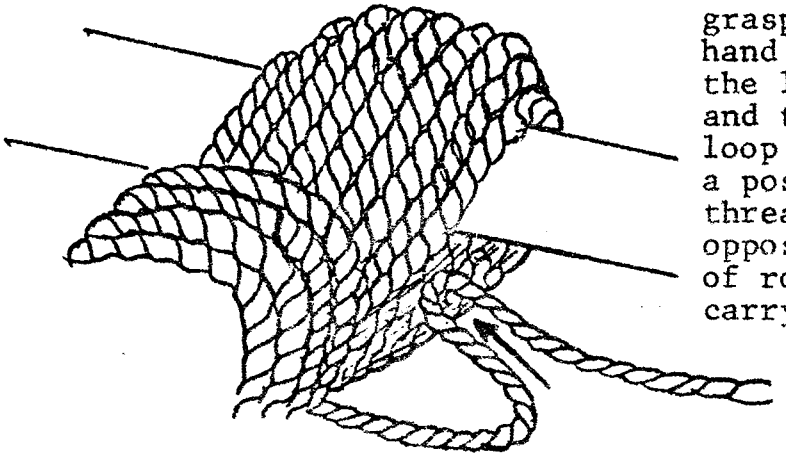


Place a half-hitch on the bar to the coilers left. In a counter clockwise direction, turn the first wrap around the bar on the right and take six wraps around posts, working upward. Take five more on top of the first six, working from the bottom up, allowing each wrap to lie in the groove between the wraps of the first layer. Take four wraps on top of the five in the same manner. Continue this method until about forty feet of rope remains.

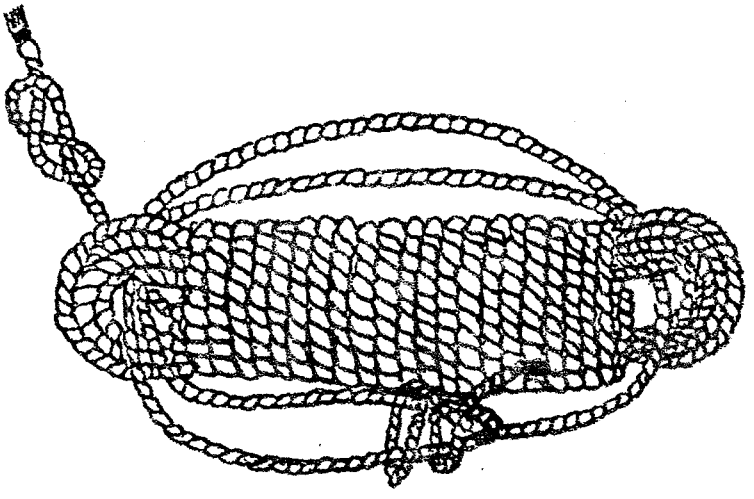




Start the outside coil wraps by bending the section of rope last laid across and around the coil on the left side. Continue outside wrap until all but about ten feet of rope is used up. Tighten wraps well; loose wraps produce a poor coil.



To make the carrying sling, grasp the loop in the right hand and push it between the last wrap on the coil and the bar. Bring the loop around the coil to a position so it can be threaded through the opposite end of the coil of rope to make a carrying sling.



Take the bitter end from the stand part of the rope and attach it to the loop with a double becket bend. Tie a figure eight knot in the opposite bitter end to identify this as the holding end when paying out the rope.

SAFETY LINE

Five-eights inch manila rope is to be used with breathing apparatus as a combination signal and life line if conditions so warrant. It is secured to the wearer with a bowline.

The safety line is useful not only in helping the wearer to find his way out, but also in helping rescuers to assist him if he should get into trouble.

CAUTION: Dragging a man out with the safety line should be done only as a last resort. Obstructions may injure him and/or pull off his face piece. It is best for outside men to don breathing apparatus and go in after him.

Communications via the safety line should be accomplished as follows: A definite tug on the rope is used to relay signals. This is accomplished by a full swing of the arm to prevent signals from being confused with jerking of the line occasioned by the normal movement of the wearer. Signals must be pronounced and definite to be felt at ends when line has passed around corners or obstructions.

Slack must not be allowed in line. The wearer and line tender must be alert at all times for signals and answer all signals promptly. All signals shall be obeyed at once except the signal to advance in which case the wearer should use his own discretion. Signals may originate from wearer or line tender and the "OK" signal should be given frequently. Failure to receive an answer to the "OK" signal from the wearer shall be cause for immediately starting action to get the man out. Do not wait for the "HELP" signal. When a wearer fails to receive an answer to his signals, he will notify his partner, start for the outside and continue to fresh air, unless able to re-establish signals enroute.

The line tender must be alert at all times and watch for the possibility of a man inside being cut off due to spread of fire or collapse of the building. He must not leave the life line unattended. One man shall not tend more than one life line.

The lifeline shall be tied snugly with a bowline knot around the waist of the firefighter. The knot is shifted to the rear of the fire fighter before he moves forward into the work area.

A standard set of lifeline signals is in use and shall be memorized by all members of the Honolulu Fire Department.

CODE	TUGS	MEANING
O	1	Okay
A	2	Advance
T	3	Take-Up
H	4	H E L P

O - Everything is all right (Give frequently)

A - Going ahead; wearer will pull. Man outside, let line slide through fingers.

T - Backing out; retreating; moving position. KEEP SLACK OUT OF LINE.

H - Emergency, assistance needed. If signal is from the inside, send in men with masks. If signal is from outside, wearer to come out immediately.

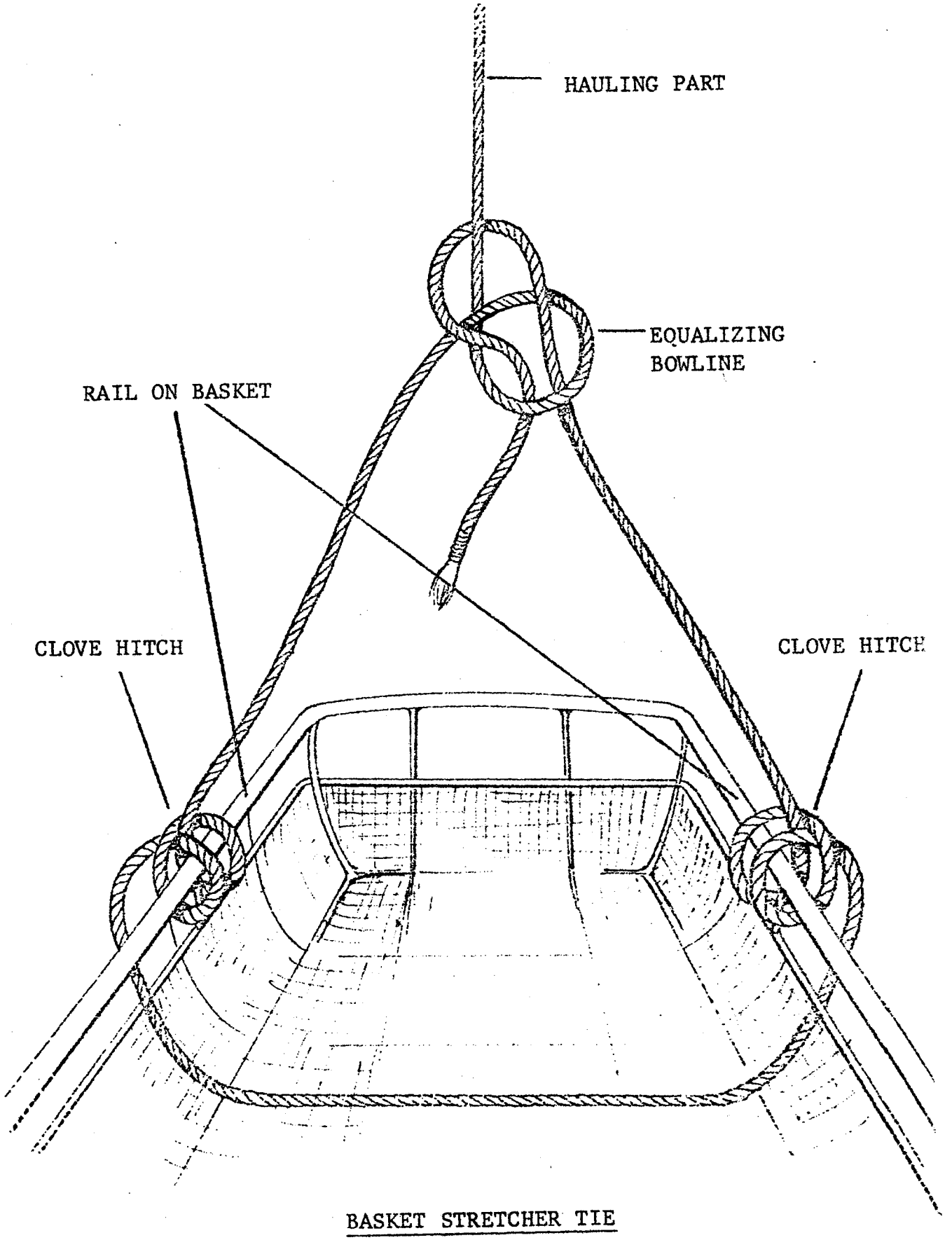
HOW TO TIE A BASKET STRETCHER FOR RAISING OR LOWERING AN INJURED PERSON

Tie the stretcher in the following manner using three 200 foot life lines.

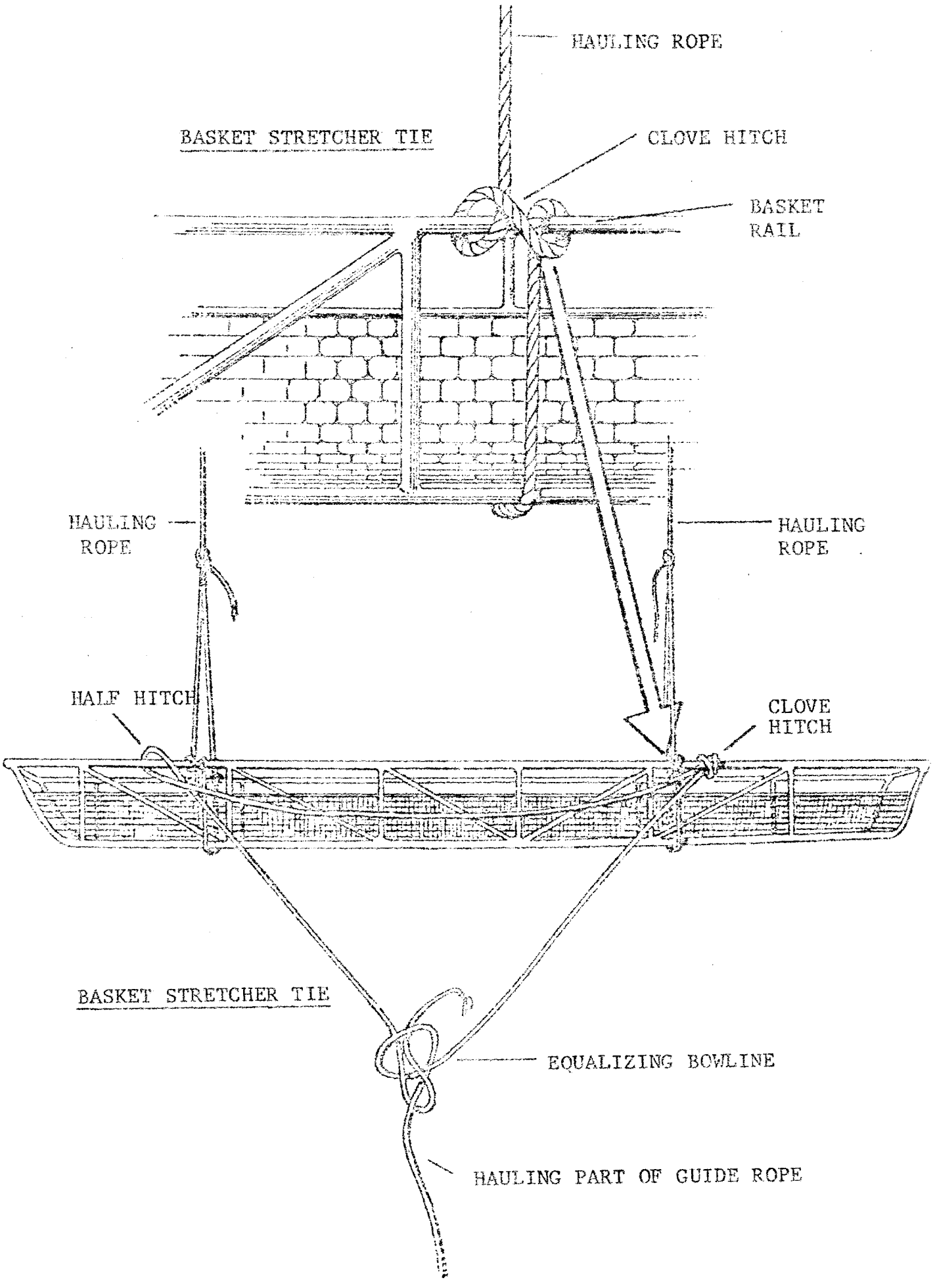
1. Measure 12 feet of rope on hauling line.
2. Pass bitter end over and around stretcher rail opposite from side at which you are working.
3. Tie clove hitch on rail at measured point of rope. (12 ft. mark)
4. Bring bitter end under stretcher and tie clove hitch on stretcher rail opposite first clove hitch.
5. Join bitter end and hauling line together with equalizing bowline.
6. Repeat instructions (1) through (5) at opposite end of stretcher using second hauling line.

Tie a guide line to stretcher in the following manner:

1. Measure 12 feet of rope.
2. Tie clove hitch on stretcher rail at measured point of rope (12 ft. mark) adjacent to hauling line on side toward foot or head of stretcher.
3. Pass bitter end of rope under rail and tie half-hitch on rail at other end of stretcher.
4. Join bitter end and guide line together with equalizing bowline.



BASKET STRETCHER TIE


HAULING ROPE
BASKET STRETCHER TIE
CLOVE HITCH
BASKET RAIL
HAULING ROPE
HAULING ROPE
HALF HITCH
CLOVE HITCH
BASKET STRETCHER TIE
EQUALIZING BOWLINE
HAULING PART OF GUIDE ROPE

LIFE BELTS

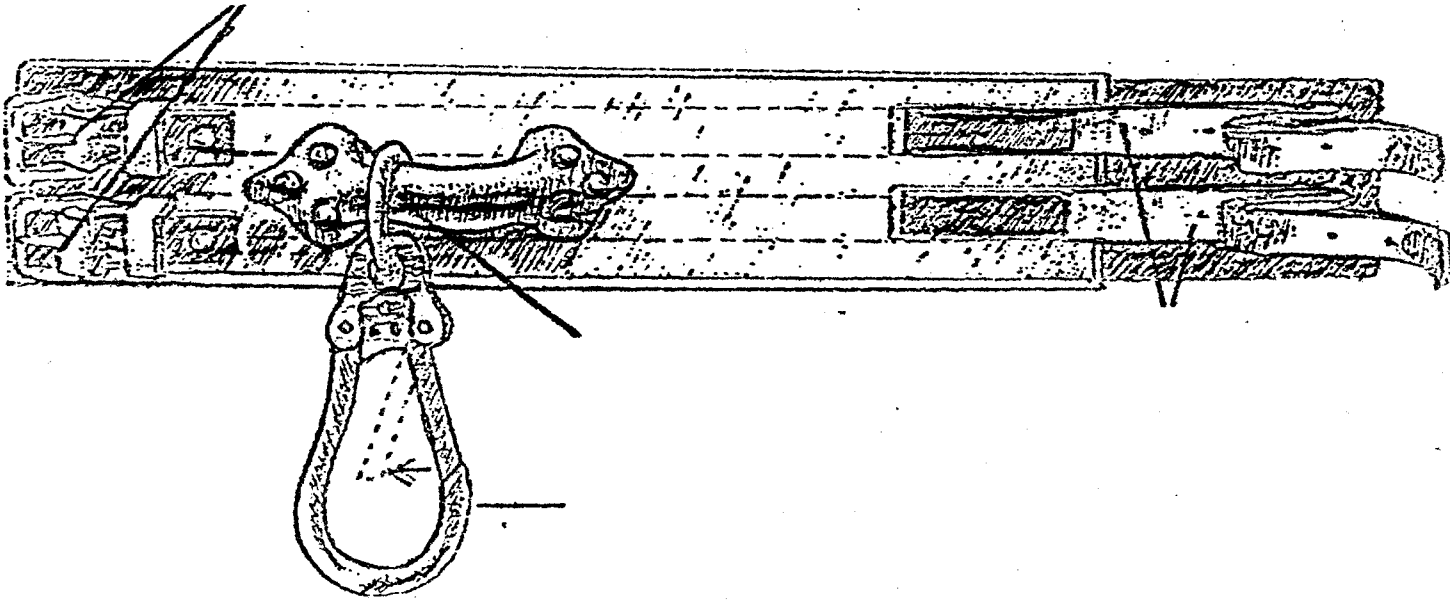
Life belts are made of extra-heavy canvas equipped with two buckles and straps plus a safety hook. They are used as safety belts for work on ladders by snapping the hook around the rung, thereby permitting the free use of both hands. The hook is also used in work with life lines in rescue work.

HOW TO PUT ON A LIFE BELT

A. Hold the buckle end in the left hand and swing the belt around the back of body.

B. Buckle both straps in front of body, taking equal tension on each strap, and put strapends in keepers.

C. Adjust belt so that hook is in front of body.



HOW TO ATTACH A LIFE LINE TO A LIFE BELT HOOK

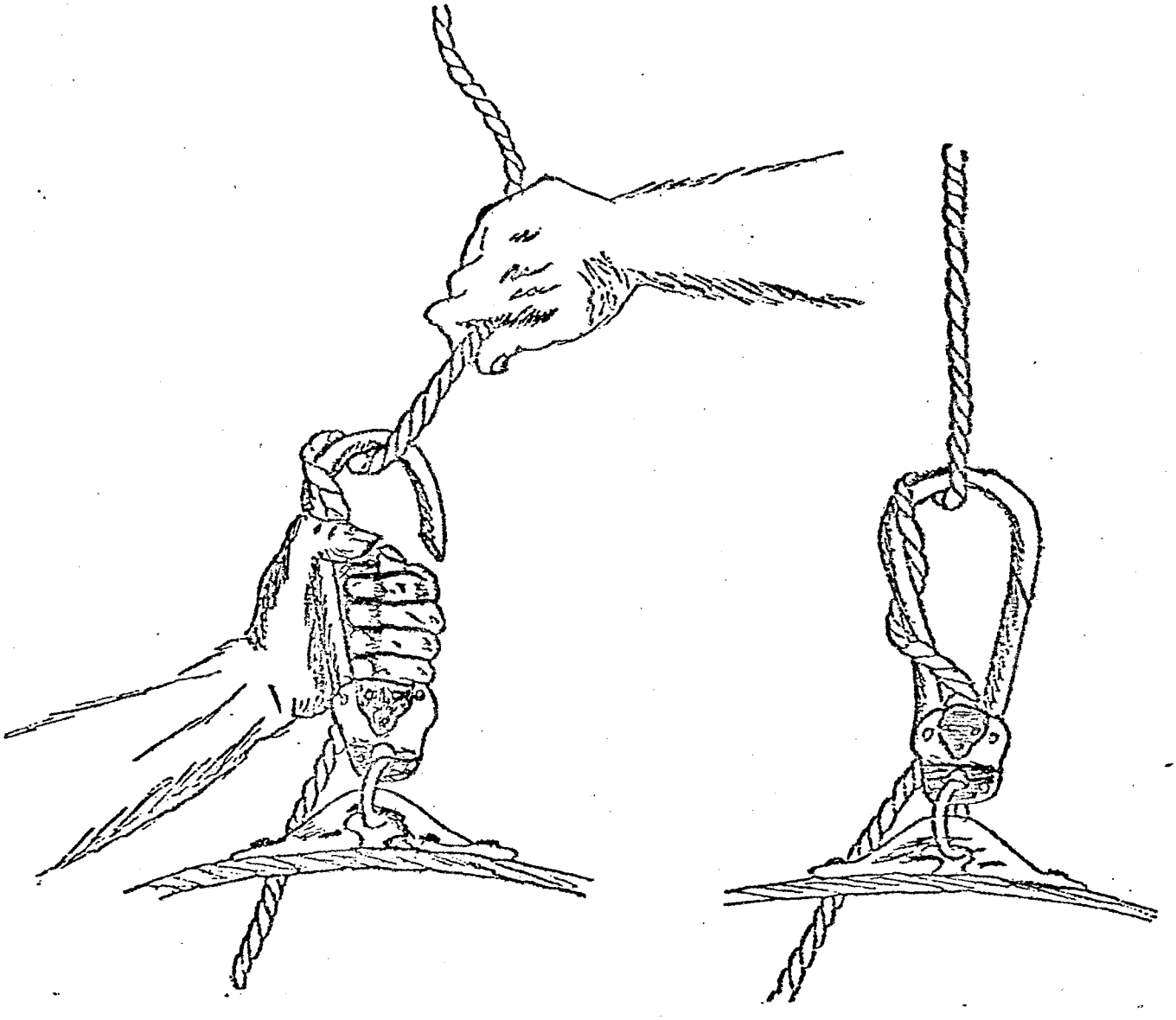
A. Hold hook and life line in left hand, snap section facing the right.

B. Bring the life line from left side and hold in right hand.

C. Snap line onto hook from the bottom side of hook.

D. Take two full turns of life line through the snap onto the hook with right hand.

E. For a slower descent, take three turns onto the hook. Always take three turns onto the hook when carrying another person while sliding the life line.



HOW TO SLIDE DOWN THE LIFE LINE WITH USE OF LIFE BELT

A. Bring the life line from your left side behind your back and hold in your right hand. The line should be across the small of the back.

B. Reach up and grasp the line with your left hand above the snap hook.

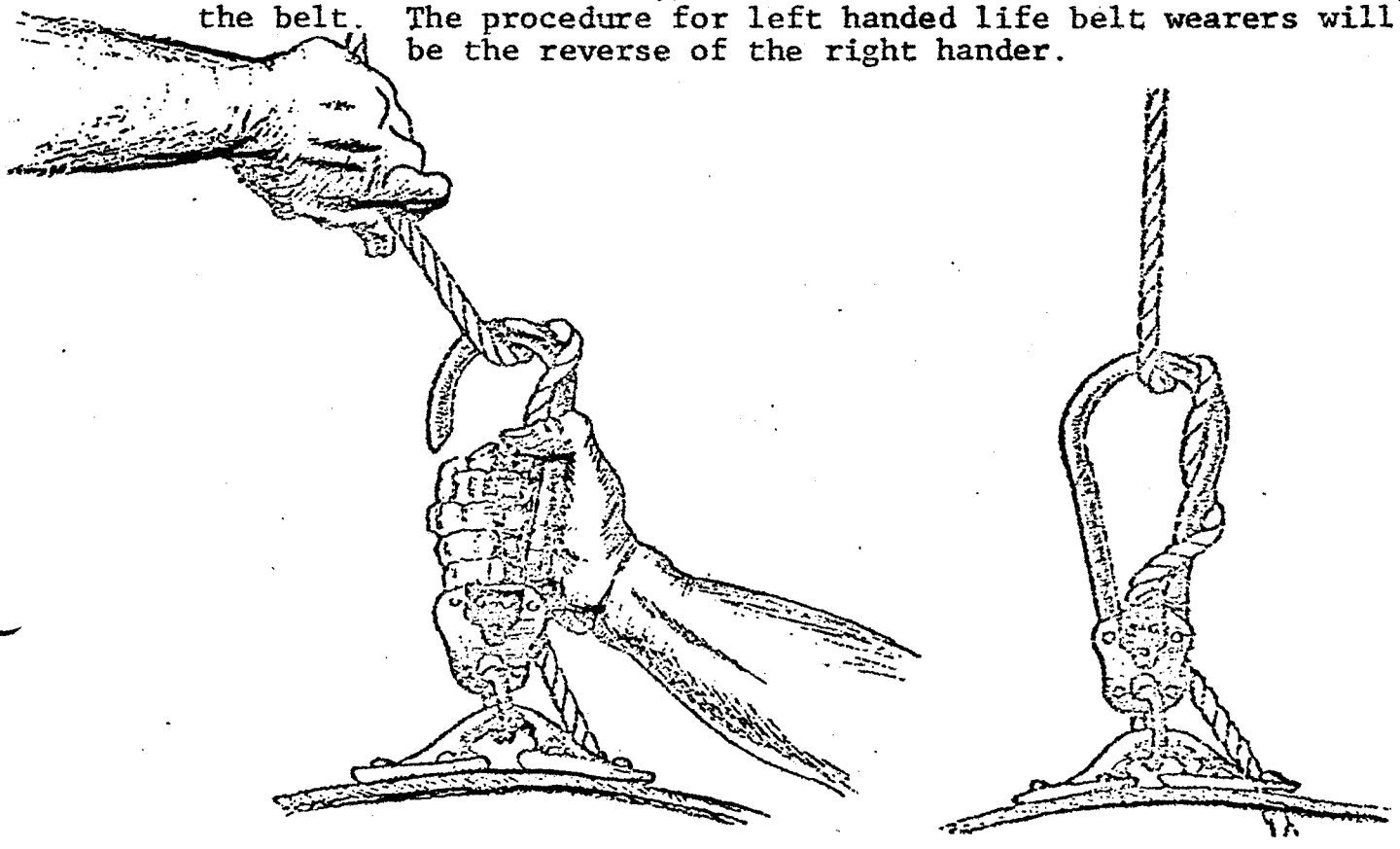
C. With your right hand holding the line at your right hip and slightly away from your body, spread your legs and lean away from the building, slowly letting the line slip through your hands until your body is almost perpendicular to the wall. Keeping your legs spread apart, let the rope slip through your hand slowly and walk backward down the the wall.

D. Use your right hand as a brake by pulling the rope tightly against the inside of your right thigh.

E. Adjust the speed of descent by bringing your right hand from inside your thigh to slightly away from your body at hip level. The closer your hand is to your thigh, the slower your descent. Don't allow your right hand to go behind your back or you will lose control of your descent.

Note: Gloves must be work at all times to prevent burning of the hands.

A left handed person must wear the life belt upside down so the snap section will be facing the left. If the life belt has an axe case attached, the axe must be removed before donning the belt. The procedure for left handed life belt wearers will be the reverse of the right hander.



LADDERS

GLOSSARY OF LADDER TERMS

AERIAL LADDER
Amechanically-operated extension ladder permanently mounted on the turntable of an aerial truck.

ANCHOR
That part of the ladder which is used to attach the halyard rope to the ladder.

ANGLE BRACES
Braces extending diagonally from a truss block and beam to adjacent truss block and truss. Their purpose is to provide further strength to the ladder.

BANGOR LADDER
An extension ladder of truss type and equipped with tormentor poles.

BEAM
The main structural part of a ladder in which the rungs are supported.

BEAM RAISE
Raising the ladder on its side with the beams one above the other, rungs in a vertical position. (Rungs at right angle to the ground.)

BED LADDER
The lower section of an extension ladder.

BRIDGING
Use of ladders above ground level to provide a walkway to cross lightwells, alleyways, roof-to-roof or window-to-window of adjacent buildings, etc. Also: the use of ladders or the sections of an extension ladder for climbing over walls, fences, etc.

BUTT
The bottom or base (foot) of the ladder.

CHURCH RAISE
A method of raising a ladder in a vertical position without the use of a solid support against which to rest the ladder. Use of ropes is made to support the ladder in vertical position

CHUTE RAISE
A method of raising a ladder in a confined area where normal raising is impracticable in which the top of the ladder is raised first and the butt slid into suitable position.

EXTENSION LADDER
A ladder of two or more sections which can be extended to increase its length.

FLAT RAISE
Raising a ladder with beams and rungs parallel to the ground on the same plane as the ground.

FLY LADDER
The upper section (sections) of an extension ladder. Its purpose is to reach elevations beyond the extent of the bed ladder.

GROUND LADDER
A descriptive term to designate the difference between ladders raised on the ground and those raised from the apparatus.

GUIDES
Light wooden strips on the inner side of an extension ladder which guide the fly ladder while it is being raised and lowered. On metal aerial ladders the strips are metal.

HALYARD
Rope or cable used to raise or lower the fly of an extension ladder.

HEEL
The bottom or ground end of a ladder.

HEEL PLATES
Metal safety plates attached to the heel of a ground ladder to stabilize the ladder and protect the beam.

HOOKS
A curved, sharp, metal device (two in number) which folds outward from each beam at the top end of a roof ladder.

"U" POLE
A 16-foot pole equipped with a metal yoke which fits onto the rungs of a ladder and is used to assist in raising ladders where the butt must be slid into position or where overhead obstructions interfere with raising of the ladder.

LOCKING PAWLS
Metal locking devices commonly attached to fly ladders. Their purpose is to lock fly ladder in place when elevated.

PULLEY
A grooved metal wheel attached to extension ladders over which the halyard is drawn when raising or lowering the fly ladder.

RAILS
The two lengthwise members of a trussed ladder beam which are separated by truss or separation blocks.

RUNGS
Cross members between beams. The purpose of the rungs is to provide footing for climbing.

SAFETY SHOES
Rubber or neoprene spike plates, usually of the swivel type, attached to the heel of a ground ladder.

SPURS
Metal reinforcements attached to the ends of ladders. Their purpose is to preserve ends of ladders and to provide better footing.

STOPS
Wooden blocks which prevent the fly ladder from being extended out of the bed ladder. On metal ladders the blocks are of metal.

STRAIGHT LADDER
A ladder build in one section only.

TIE RODS
Metal rods placed under rungs and through both beams. Their purpose is to tie one beam to the other beam.

TOGGLE
A device by which a tormentor pole is attached to a ladder.

TOP or TIP
The topmost point of a ladder.

TORMENTOR POLES
Poles equipped with toggles which are attached to upper end of the beams of a bed ladder by means of toggle swivels. Their purpose is to assist in raising and lowering, guiding and steadying 50-foot extension ladders.

TRUSS

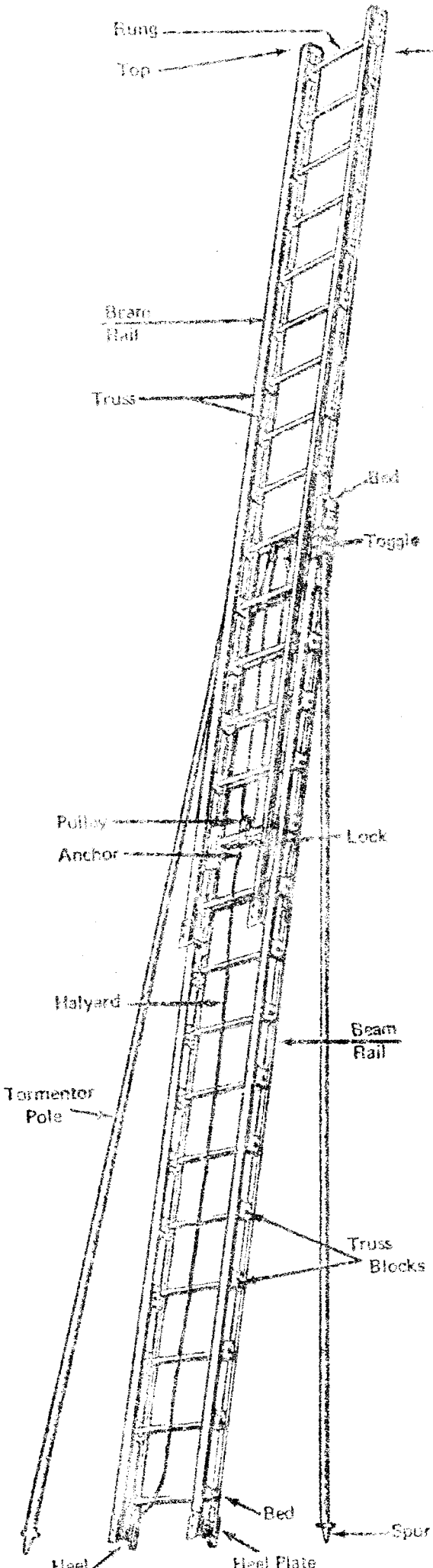
The tension member parallel to the beam. It is separated from the beam by truss blocks and braces. The purpose of the truss is to add strength to the beam.

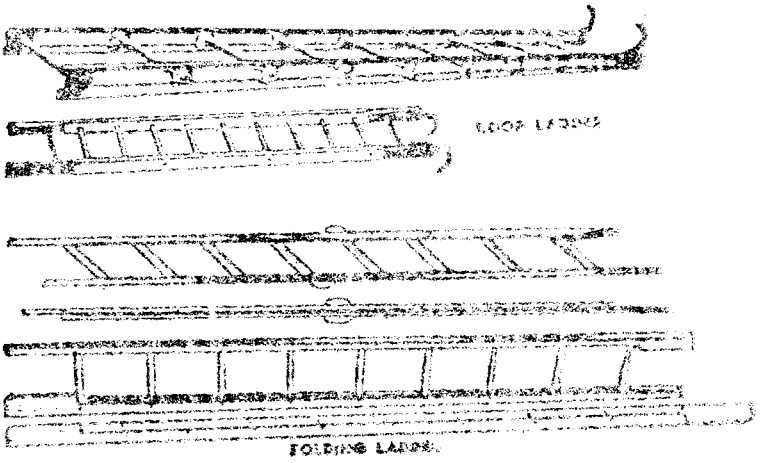
TRUSS BLOCKS

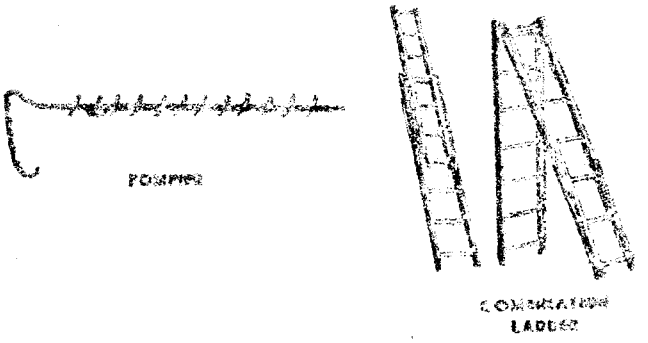
Spreaders set at 90 degree angle to the beam and the truss. Their purpose is to separate truss from beam and to stiffen the ladder.

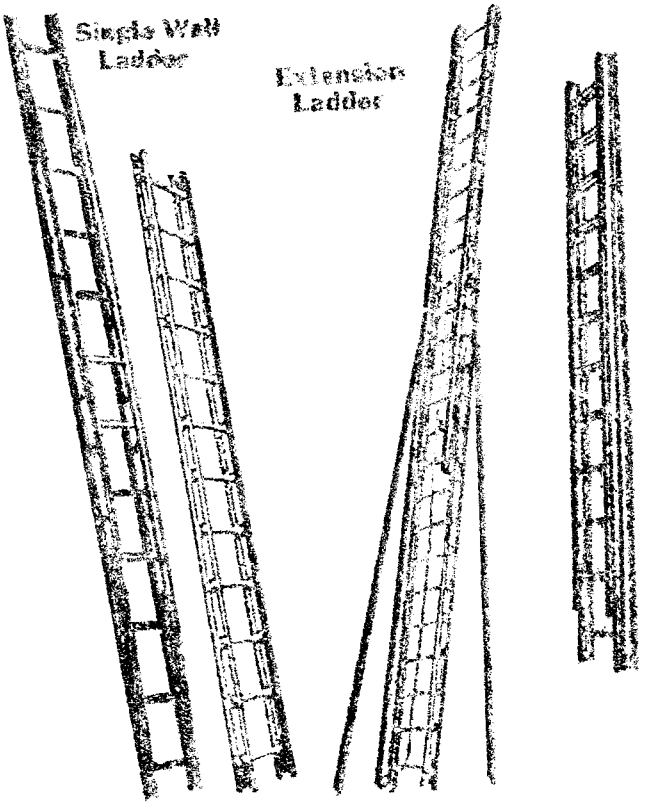
TRUSS RAIL

The longitudinal members of the ladder truss.


Rung
Top
Fly
Beam
Rail
Truss
Bed
Toggle
Pulley
Anchor
Lock
Halyard
Beam
Rail
Tormentor
Pole
Truss
Blocks
Bed
Spur
Heel
Heel Plate


LOOP LADDER
FOLDING LADDER


POMPIER
COMBINATION
LADDER


Simple Wall
Ladder
Extension
Ladder

STRAIGHT LADDERS

A straight ladder is nonadjustable in length and it consists of but one section. Its size is designated by the overall length of the side rails. The straight ladder is sometimes called a wall ladder and it is used for quick access to windows and roofs of one and two story buildings. Straight ladders must be constructed to have a maximum strength and minimum weight and they may be of the trussed type in order to reduce their weight. Straight ladders are generally used in lengths of 12, 14, 16, 18 and 24 feet but some longer straight ladders do exist.

EXTENSION LADDERS

An extension ladder is adjustable in length. It consists of two or more sections which travel in guides or brackets to permit length adjustment. Its size is designated by the length of the sections measured along the side rails when fully extended. Extension ladders provide access to windows and roofs within the limits of their extendable length. Most of the longer extension ladders are of the trussed type and and the extra long ladders are usually equipped with stabilizing poles. These poles are called tormentor poles. Extension ladders are heavier than straight ladders and more manpower is needed to safely handly them. Extension ladders are heavier than straight ladders and more manpower is needed to safely handle them. Extension ladders generally range from 24 to 50 geet in length.

COMBINATION LADDER

A combination ladder is adjustable in length and it also has a suitable means for locking the sections together so that the two sections can form equal angles with the floor or ground as a stepladder. The size is designated by the length of the sections.

ROOF LADDERS

A roof ladder, as indicated by its name, is designed for only one specific function. It may, however, be used for other purposes if conditions warrant its application. Roof ladders are equipped with folding hooks at the top end. These hooks provide a means of anchoring the ladder over the roof ridge or other roof part. Roof ladders are generally required to lie flat on the roof surface so that firefighters may stand on the ladder for roof work. Their length varies from 12 to 20 feet unless otherwise specified.

FOLDING LADDERS

Folding ladders provide a means of reaching through openings into attics and lofts and other areas which are somewhat difficult to reach without a special ladder. Folding ladders are constructed so that they can be folded or collapsed for small room or closet work. Folding ladders are usually short in length, since they are only required to reach a short distance.

AERIAL LADDERS

An aerial ladder is a mechanical unit that is mounted upon a specially built chassis. This mechanical unit is generally operated by hydraulic power. The source of power is usually derived from the apparatus engine which actuates a hydraulic hoist. Aerial ladders are currently constructed of metal and trussed to provide adequate strength. Aerial ladders generally range in length from 65 to 100 feet, but longer aerial ladders are used.

ELEVATING PLATFORMS

Although elevating platforms are not generally considered to be ladders, some elevating platform apparatus carry ground ladders. This apparatus has some features which are similar to aerial ladders but they are primarily a portable elevator controlled by an operator. They are discussed here to clarify their use.

POMPIER LADDERS

The pompier ladder consists of a single beam through which rungs project and they have a large goose-neck hook at the tip. At one time the pompier ladder was used by firefighters to reach upper stories of tall buildings but their use has diminished greatly. There are no pompier ladders in service in the Honolulu Fire Department.

DESIGN AND CONSTRUCTION

Although present national specifications for fire service ground ladders recommend that they should be made of metal, wood, constructed ladders can be supplied by some manufacturers. To some degree, metal ladders are more desirable than wood and a high grade wood stock is sometimes difficult to obtain. A plastic lamination of fiberglass materials is also used in the construction of ladders and this material shows some promise of good results. The manner in which fire service ground ladders are designed is directly related to the materials used.

ALUMINUM ALLOY LADDERS

Fire service metal ground ladders are usually built with heat-treated aluminum alloy. Three pincipal reasons for using aluminum are that is is light in weight, has adequate strength and permits a reliable visual inspection of all ladder parts. It is sometimes difficult for a person to perform a comparable visual inspection of wood ladders, since pitch pockets, knots nodes and other defects may sometimes be concealed.

Aluminum ladders usually require less maintenance than wood and an artificial coating to protect their exterior is not necessary. It is comparatively simple process to keep an aluminum ladder clean and other maintenance requirements are seldom necessary. Aluminum alloy offers a splinter-free surface that is not subject to water absorption and dry rot. There are, however, some disadvantages to aluminum for fire department ladders. One objectionable characteristic is that aluminum is a good conductor of electricity. CAUTION MUST BE EXERCISED WHENEVER METAL LADDERS ARE USED NEAR ELECTRICAL POWER SOURCES. The need for this precaution should not preclude the use of metal ladders if all firefighters have been informed of this characteristic.

STEEL ALLOY LADDERS

The need for lightweight materials in the construction of straight and extension fire department ladders has been established. Because of this desirable characteristic, the use of steel alloy for these manually-operated ladders is not practical. The use of steel, however, does not present a serious problem when the ladder is power operated. Although the tensile strength of steel alloy is only slightly more than aluminum alloy, it is sometimes preferred for aerial ladder construction. Solid steel ladder beams would add excessive weight but they would still not increase the tensile strength of the ladder a noticeable amount.

The supporting beams of power-operated ladders are, therefore, usually truss constructed. Trusses may be formed by several methods, but engineering design has proven that trusses lend more strength if their assembled members form triangles or a combination of triangles. Aerial ladder trusses consist of an assembly of hollow tubing bars that are fastened together in triangular shapes to form a rigid framework.

WOOD LADDERS

Douglas Fir has long been a favored wood for ladders because it is relatively free from knots, checks, pitch pockets and wind shakes. Ladder stock has always been select quality lumber milled from extremely tall fir trees.

The rungs for wood ladders are usually made from second-growth white ash or hickory. Second-growth wood is derived from a stump of a tree that has been felled. These second-growth shoots are split before turning so that the grain will run the full length of the rung.

LADDERS OF OTHER MATERIALS

The use of plastic materials for construction of fire service ladders is undergoing study. Fiberglass and plastic ladders have been used by public utility companies because of their non-conductive electrical properties. Such ladders do not, however, generally have the strength required for fire service. Combustibility, temperature resistance, and rigidity are other factors to be considered when evaluating such new materials in comparison with the more traditional wood or metal ladders. A ladder which is a composite of various materials may eventually be developed to meet the demanding requirements of the fire service.

TRUSS CONSTRUCTION IN LADDERS

The term "truss" means to support, strengthen or stiffen as a beam. The principle of the truss is applicable to manually operated ground ladders. The truss assembly in a metal ground ladder is usually formed between two parallel rails, where the strength of the truss is dependent upon the strength of the metal. Wood truss beams also have two rail members and these beams are separated and held secure by wood separation blocks. Unlike metal ladders, one rail member of wood truss beam is usually curved. Because of its curvature, this rail member is sometimes referred to as the top or truss rail.

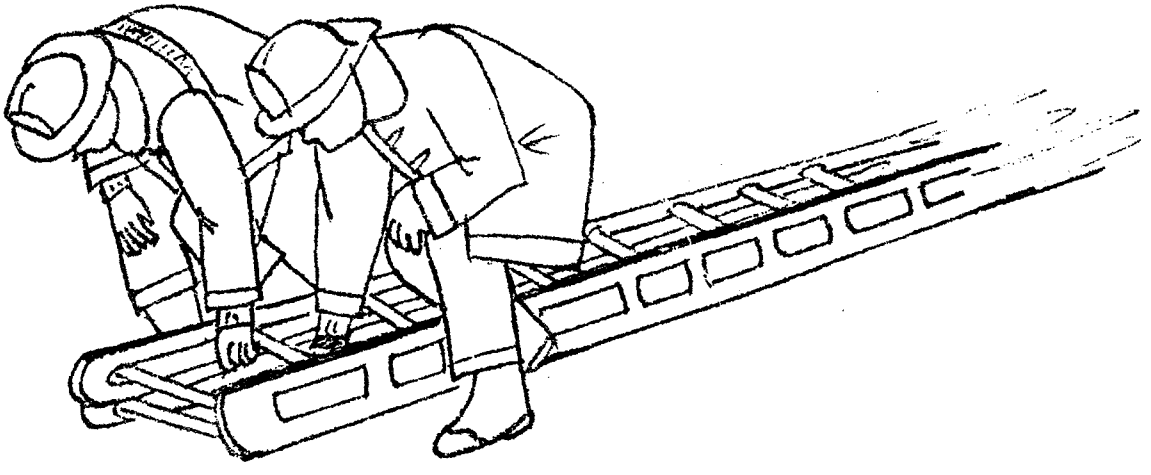
The truss rail is bowed at its middle to form the truss and is shaped by the truss blocks. The other rail member, being straight, is usually referred to as the main rail and is slightly larger than the truss rail. When the truss rail of a wood ladder is placed toward a building with the top end supported, the truss rail is under tension. The curvature of the truss rail, as it forms the truss, increases the tensile strength of the ladder. The line drawing below is an exaggerated illustration of how blocks shape the curve of a truss rail and how the assembly forms a completed trussed ladder beam.

Proper Method of Lifting

Before proceeding further, a note of precaution should be given regarding the proper method of lifting or lowering a ladder from or to the ground.

Serious, and not infrequently, permanent back injury has been sustained by men using their back muscles to lift a heavy ladder or piece of equipment by bending their body from the waist and then straightening up to lift.

The heavy muscles of the thigh and the muscles of the arm are the ones that should be used in lifting, not the muscles of the back. The correct body position for lifting is to bend the knees, keeping the back straight and lift by using the muscles of the legs and arms as the legs are straightened.



LADDERING A BUILDING

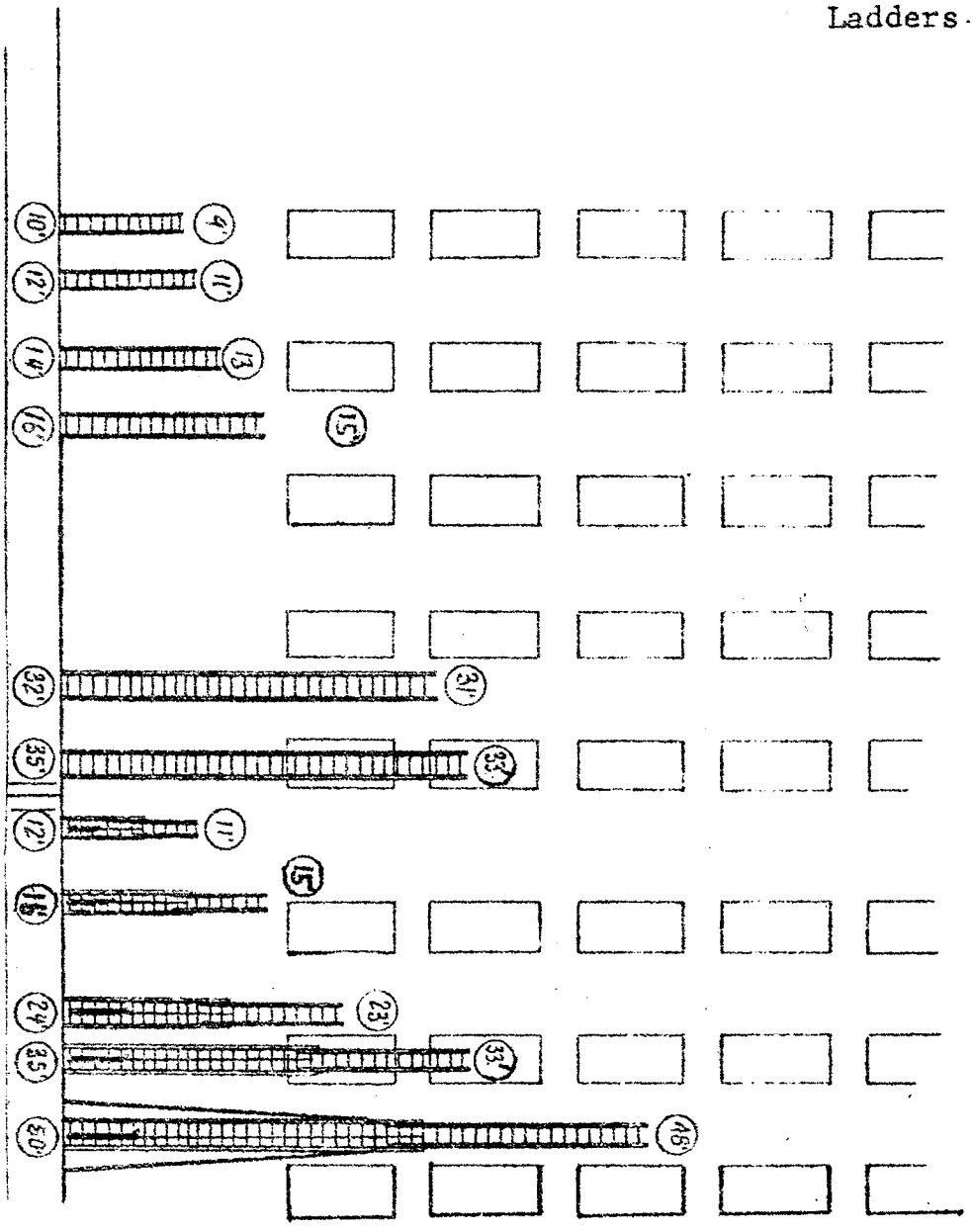
The three-position approach to fire fighting has fundamentally been a good practice for many years. These positions are at exposures, at avenues of fire spread and at the point of origin. Fires of any magnitude must be attacked from these three positions of approach if control and extinguishment are to be accomplished. Many times the approach is accomplished by the prompt placement of ladders for hose lines, rescues and ventilation. It is very important for firefighters to be trained in the skills of manipulating ground ladders, but the actual placement of ladders at fires should not be dismissed with the term "Ladder the Building".

A chief officer on a first alarm response, has many duties to perform and responsibilities which claim his attention. An additional duty of leading a ladder crew by the hand, so to speak and supervising the raising of ladders should not fall upon his shoulders. A fire captain may direct the process of laddering a building but a trained ladder crew should not require much supervision.

SELECTING THE LADDER FOR THE JOB

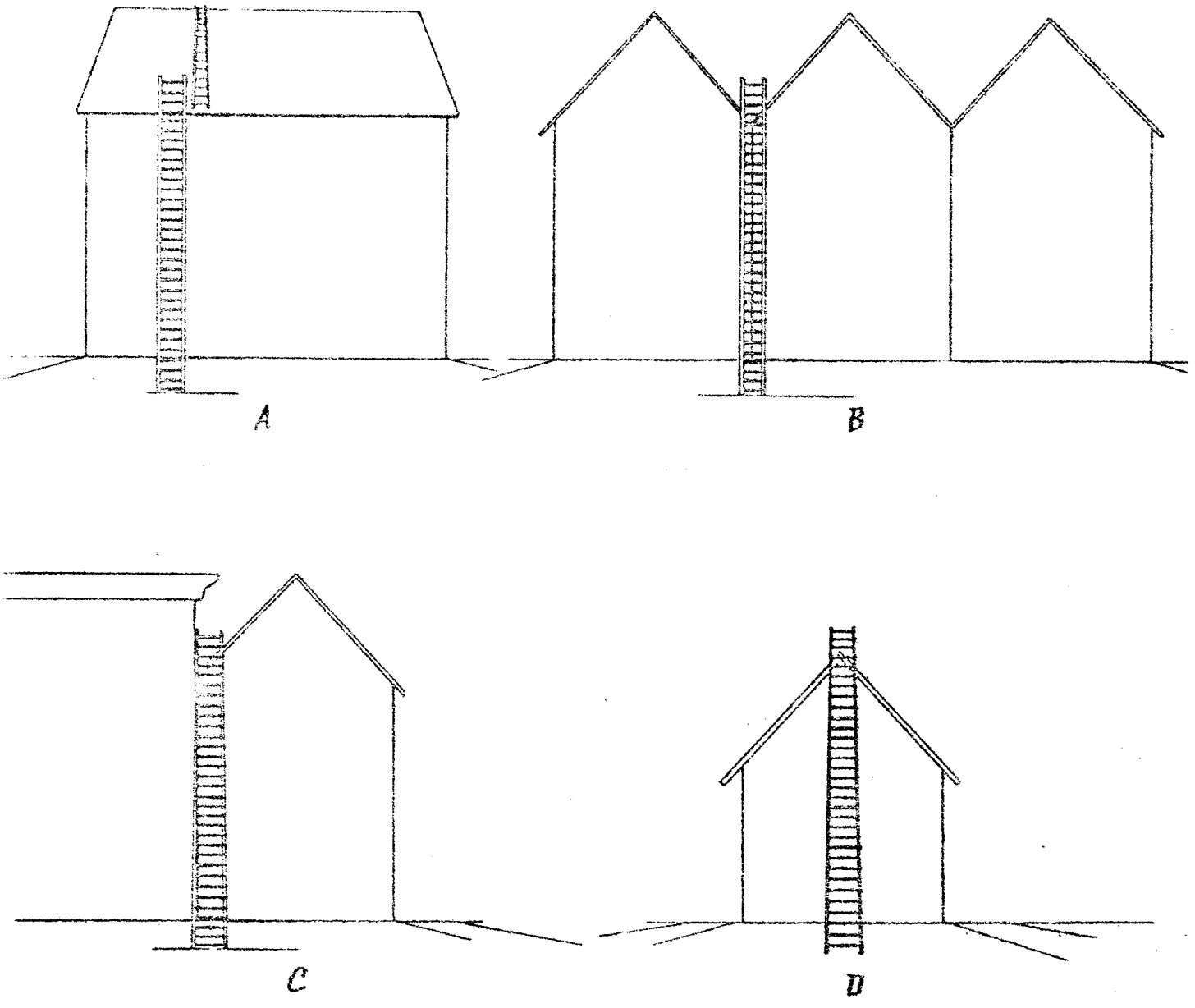
The designated length of ground ladders is derived from a measurement on the basis of their maximum usable length. These lengths have been established according to the places where they will normally reach. The 50-foot extension ladder will normally reach fourth floor windows and under some circumstances, the roof of a four-story building. Increasing the length of an extension ladder beyond 50 feet results in excessive weight, reduce safety and impractical application. The 35-foot extension ladder is probably the most versatile of all extension ladders. It will reach the roofs of some three-story buildings and it may also be used to reach elevations of 20 or 30 feet high. The 20-foot straight ladder will reach a second story window and is frequently applicable in preference to the extension ladders.

When selecting a ladder for a specific purpose, it is desirable and good practice to have the ladder extend a few feet (preferably three rungs) beyond the window sill or roof edge. This extension provides footing and handholds for persons stepping on or off the top of the ladder. When ladders are used to rescue persons, they may or may not be spaced for maximum strength and a weight beyond that which would normally be used is sometimes applied. Fire service ladders are also not always used in a vertical position, for horizontal spans are sometimes made. All of these uses and adverse conditions require the factors of strength and stability to be considered in addition to the factor of length.



Unless absolutely necessary, ladders should NOT be placed:

1. In front of entrances and exits where ingress and egress might be obstructed.
2. Into or against burning windows or other burning surfaces.
3. Against rounded overhanging roof surfaces, or against the slope of a pitched roof where the stability of the ladder might be endangered.
4. In such a manner that ladder spurs straddle hose lines.
5. In such a manner as to form a condition conducive to serious bodily harm.



LADDER PLACEMENT TO PITCHED ROOFS

Whenever adequate clearance is available, the ladder should be placed to the base of the roof slope as shown in Figure A. If it is not possible to place the ladder to the base of the roof slope, the ladder may be placed to the valley of adjoining roof slopes as shown in Figure B, or placed so as to rest securely against an adjoining building as shown in Figure C. The ladder may be placed to the peak of the gable as shown in Figure D, provided that the ladder rungs are not permitted to rest against a roof ornament or to rest against the peak of the roof.

NUMBER OF MEN PERMITTED ON LADDERS

A general safe rule for ladder loading is: One man for each 10 feet of ladder length up to 30 feet. This rule applies to ladders build specifically for fire service and not to commercial type ladders.

The following table of recommended safe loads is based upon the average weight of a man being 175 pounds, and upon the ladder being properly raised and placed at an angle of 70 degrees. This table also applies only to ground ladders and allows for added loads such as when emergency rescue is necessary.

Length	No. of Men	Length	No. of Men
12-ft	1	24-ft	2
14-ft	1	35-ft	3
18-ft	1	50-ft	3

Roofing ladder, suspended pendant: 1 man
Roofing ladder on pitched roofs: 3 men

The following table provides guide for recommended safe loading of aerial ladders at several angles of inclination. It is based upon the proper placement of the apparatus and assumes the load to be evenly distributed on the ladder:

100-foot Aerial

Fully Extended and Supported at Top

Angle of Inclination:	0 Deg.	30 Deg.	45 Deg.	70 Deg.
Number of Men:	3	4	5	8
Limit of Top Fly:	2	2	2	2

Fully Extended and Not Supported at Top

Angle of Inclination:	45 Deg.	60 Deg.	70 Deg.
Number of Men:	2	2	3
Limit on Top Fly:	1	1	1

Selecting a ladder to do a specific job or to perform a special purpose requires firefighters to be a good judge of distance, stresses and strength. Roughly speaking, a building story will average 12 feet from floor to floor and the distance from the window sill to the floor is about 4 feet. In general, the following table can be used for selecting ladders:

First story roof	16 to 20 feet
Second story window	20 to 28 feet
Second story roof	28 to 35 feet
Third story window or roof	35 to 50 feet
Fourth story roof	over 50 feet

Spacing and Securing Ground Ladders

An easy way to determine the distance that the heel of a ladder should be placed away from a building is to divide by one fifth the length of the ladder that is used and add two. The length of the ladder used is considered to be the length of the ladder from where it touches the building to where it touches the ground. For example, if 20 feet of a 24 foot ladder is used, the heel should be 6 feet from the building. (20 divided by 5 plus 2). If all of the 24 foot ladder is used, the heel should be placed 7 feet from the building. Overhanging cornices and other projections must be considered when the ladder is placed into position so that the heel of the ladder will be the proper distance out from the point against which the top of the ladder rests.

Ladder Climbing

Ladder climbing should be done smoothly and rhythmically. In order to develop form, the climber should ascend the ladder in a manner that will minimize bouncing and swaying. This smoothness is accomplished by permitting the climber's bent knee to ease the weight on each rung.

It is a good policy to check the angle of the ladder before a climb is made. This can be quickly and easily accomplished by standing erect at the bottom of a ladder and reaching straight forward with the arms. If, with the outstretched arms, the hands or finger tips can grip the rungs, the ladder is spaced near the correct angle.

Before a firefighter begins his climb on a ladder, he should take some common sense precautions. Some examples of things that can be checked at a glance before a climb are:

- Examine the ladder heels to be sure they are on firm footing.
- Observe the top of the ladder to see whether it rests firmly in a proper position.
- See whether the locks are properly seated over a rung.
- Check the tormentor poles to see if they are properly set.
- Check to see that the ladder is raised right side up.

The climb may be started when the ladder is properly secured. An individual may use either hand and foot to start a climb and the other extremities that are used may be on the same side of the body or on opposite sides. (right hand-left foot, left hand-right foot or right hand-right foot, left hand-left foot). Both should be tried and an individual determination made. The eyes of the climber should be focused straight forward with an occasional glance at the top of the ladder. The climber's arms should be kept straight during the climb which will keep the body away from the ladder. This distance from the ladder also permits free knee movement during the climb. The hands should grasp the rungs with the palm down and the thumb on the underneath side of the rung.

The climber should grasp every other rung in making the climb. All of the upward progress should be a result of push of the leg muscles and not pull of the arm muscles. The arms and hands should not reach upward during the climb, for reaching upward will bring the body out of erect posture and too close to the ladder.

Many times during fire fighting, a firefighter is required to carry equipment up and down a ladder. This procedure interrupts the natural climb either by the added weight on the shoulder or the shoulder or the use of one hand to hold the item. If the item is to be carried in one hand, it is desirable to slide the free hand under the beam while making the climb. This method permits constant contact with the ladder. Whenever possible, a handline rope should be used to hoist tools and equipment.

Safety Measures for Climbing

The number of men that may work from a ladder at one time must be limited to provide a margin of safety. The rule of thumb

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Safety Measures for Climbing

The number of men that may work from a ladder at one time must be limited to provide a margin of safety. The rule of thumb

is to space one man for every ten feet of ladder. When it is necessary to perform a rescue down a ladder, all other loads and activity should be removed and that ladder should be securely anchored at both the top and heel when possible.

Firefighters are sometimes required to perform work while standing on a ground ladder, and they should have both hands free to perform the task. If a firefighter is equipped with a ladder safety belt he can secure himself to the ladder. Safety belts are not always provided and worn and it is then necessary to tie in on a ladder by using the leg-lock. To apply the leg-lock, a firefighter should first stand with both feet on a common rung at the point where the work is to be performed. He then should raise one leg upward and over two consecutive rungs. This procedure places the bend of the knee over the second rung. By leaning the body forward toward the ladder, this foot and leg can be brought back through the ladder just below the rung that supports the knee. This foot can then be placed over the top side of the beam, and the other foot against the opposite beam for added stability. The leg-lock should be made opposite the side from which the work is to be performed. An extremely long-legged of short legged man may need to alter this procedure to make the leg-lock comfortable to him.

STRAIGHT LADDERS

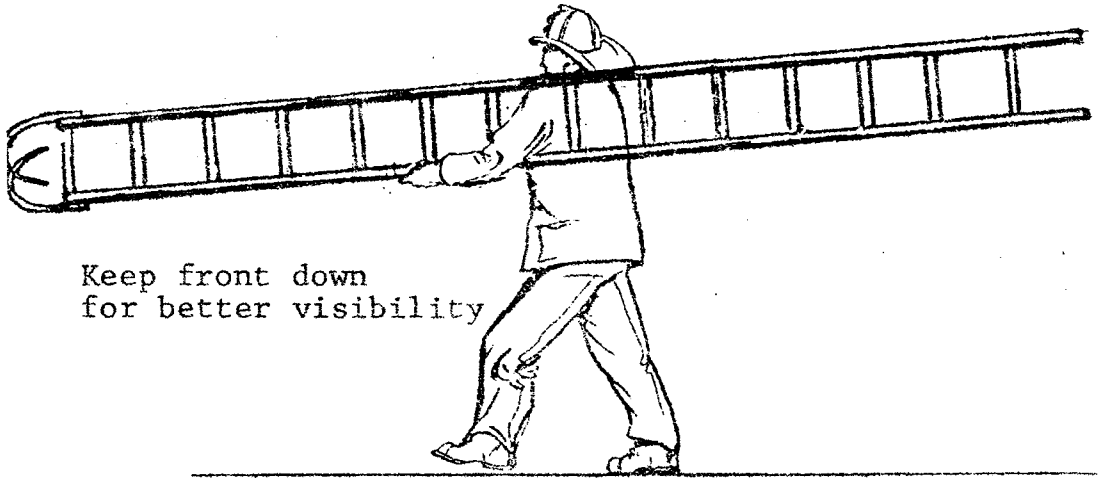
Carries and Raises

Because of the varied lengths and limited space on ladder apparatus, the shorter lengths of ladders are usually nested or racked inside the longer lengths. The nesting process may sometimes make it necessary to remove more than one ladder for an operation. For safety reasons, unused ladders from a rack should either be replaced on the apparatus or placed on the ground near the apparatus.

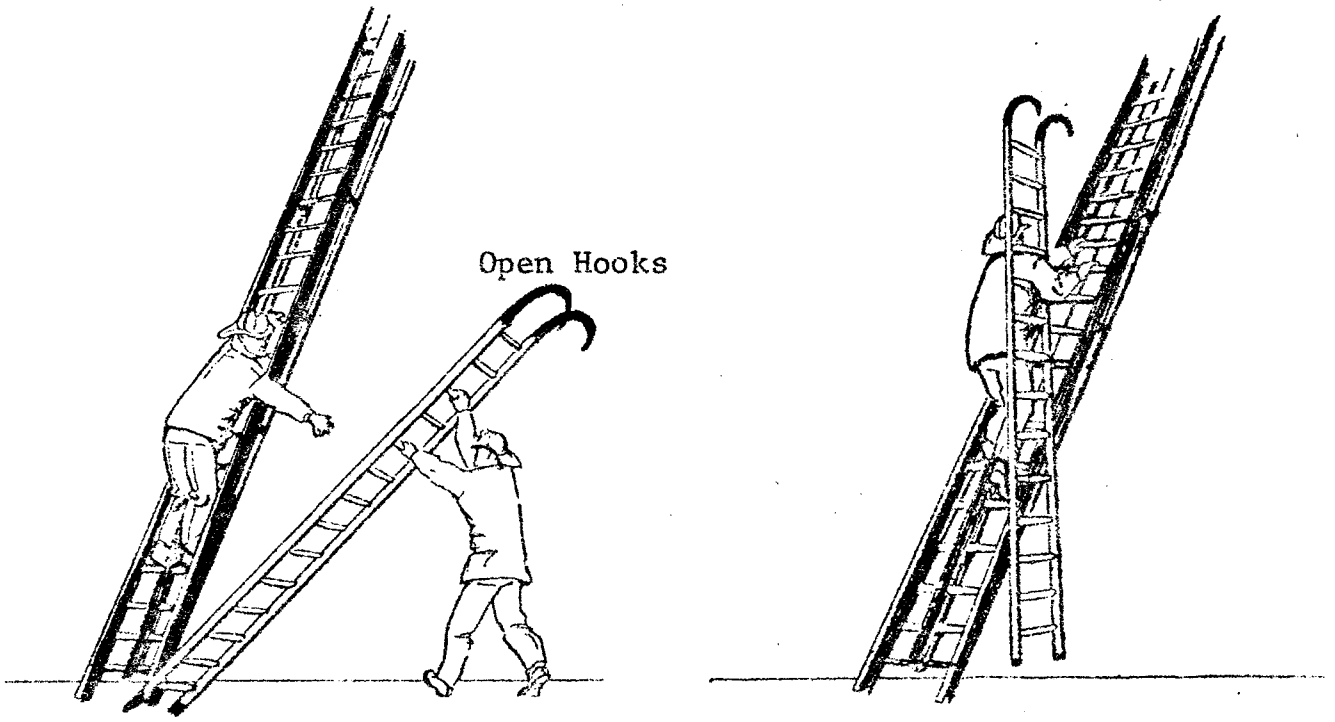
The removal of straight ladders should be directly back from the apparatus and in a level plane. The first man should always look over the area where the pull is to be made to be sure of safe footing. His pull should be uniform to prevent binding or tilting of the ladder. The second man should stand at the rear of the ladder tier and tell his partner to stop when the end of the ladder nears the end of the rack. At this point, he grasps the ladder near the end for the carry.

One-Man Carry

Although two men should remove a straight ladder, the shorter lengths can be carried and raised by one man. For the one-man carry, select a balance point near the center of the ladder, insert one arm between the beams, and place the upper beam upon the shoulder. Steady the ladder with both hands and lower the front end slightly for the carry.



ONE MAN LADDER CARRY



PLACEMENT AND CARRY OF ROOF LADDER

LADDER COMMANDS

Take Hold

The laddermen face the top of the ladder. (opposite the butt) Upon command "take hold", they bend at the knees, keeping their backs straight, and grasp the truss or one of the rungs with their inside hand.

Shoulder

Upon command "shoulder" the laddermen lift the ladder using their leg and arm muscles. In one continuous motion they do an about face by pivoting and continue to lift until the ladder is shouldered.

Forward March

When command "forward march" is given, everyone steps off which his left foot regardless of his carrying position.

Change Shoulder, Change

Used when it is necessary to reverse directions.

Upon command "change shoulder", the hand opposite the shoulder the ladder is resting on grasps the beam in front of the shoulder. Upon the command "change", the laddermen reverse their direction and shift the ladder to the other shoulder. Commands are given as the left foot strikes the ground.

Prepare to Butt

A warning command given by the ladder commander to prepare the other laddermen that the butt man will soon be lowered.

Butt Down

The butt man lowers his end of the ladder to the ground and places his foot or feet on the bottom rung or at the base of each beam. Reaching down the butt man grasps an appropriate rung and leans backward to assist in the raise. As soon as the butt man has assumed his position the beam men lift the ladder from their shoulder and keeping the ladder at arms length advance hand-under-hand down the beams raising the ladder to the vertical position.

Prepare to Extend Fly, Extend

When the ladder has reached the vertical position and has been steadied by the beam men and the butt man, the command "prepare to extend fly" is given. Upon the command "extend", the fly is extended. Either of the beam men may extend the fly.

Lock

When the ladder has been extended to its desired height the butt man gives the command "lock". Either the butt man or the beam man raising the ladder can lock the locking pawls.

Place Ladder

After the ladder has been extended and locked to the desired height, the command "place ladder" is given. The ladder is then lowered against the building.

Prepare to Retract Fly

Push ladder away from the wall.

Retract

Reverse procedures for extending the fly.

Lower

Reverse procedures for raising ladder.

One-Man Raise

When one man is required to raise a short straight ladder, it should be heeled or butted against a building or object. Conditions may not always permit a free maneuver of the ladder which may limit the one-man raise to a particular situation. The following steps should be used when raising a straight ladder:

Place the heel of the ladder against the building at ground level, grasp the ladder by the beam and rung, and lift the ladder from the shoulder until the ladder lies flat above the head with the arms straight.

Advance, hand-over-hand, down the rungs until the ladder is in a vertical position against the building.

Stand to one side of the ladder, place one hand high on a rung to hold the top in, and place the other hand low on a rung to move the heel away from the building. Space the ladder at the proper angle.

Two-Man Carry

A two-man straight ladder carry requires one man at each end of the ladder. The men carry the ladder on its side with the upper beam either resting on their shoulders, or at arm's length. Each man should stay close to the end of the ladder to prevent it from hitting obstructions during the carry and the heel or butt should usually be carried forward.

Shoulder Carry

As the straight ladder clears the apparatus, each man turns the ladder on its side, inserts either his right or left arm between the beams, and places the upper beam upon a common shoulder.

Arm's Length Carry

As the ladder clears the apparatus, each man turns toward the heel of the ladder, grasps the outside of the beam and permits the ladder to swing alongside his leg at arm's length.

Two-Man Raise

It makes little difference whether a straight ladder is raised parallel or at right angles to a building because it can always be pivoted after it reaches the vertical position. The flat raise is, however, more naturally adapted to the right angle position. It is the responsibility of the man at the heel of the ladder (heel-man) to select the location for the raise, space the heel from the building, and determine if the ladder will be raised parallel or at right angles to the building. Therefore, the butt-man or heel-man shall give all commands and cause them to be carried out.

When the location for the raise has been reached, the Heel-man calls "butt down" and lowers the butt of the ladder to the ground and faces the beam man. He places both heel plates on the ground, and heels the ladder with the ball of each foot on the bottom rung or either beam. From a crouching position, the heel man grasps the two ladder beams, one in each hand, and then leans back so that his weight will help raise the ladder.

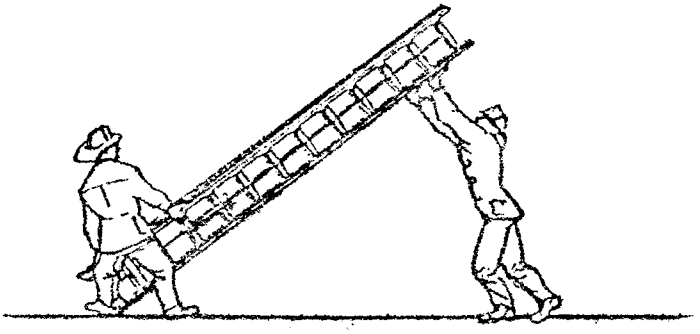
The beam man grasps a convenient rung and rests the top of the ladder on his shoulder. After the heel man is in position, the beam man swings under the ladder. With his arms extended, he then advances, hand-over-hand, down the rungs toward the heel man until the ladder is in a vertical position.

Both men face each other through the ladder and pivot the ladder if necessary. The beam man then places one foot on the bottom rung, and both men lower the ladder gently to the building under the direction of the butt man.

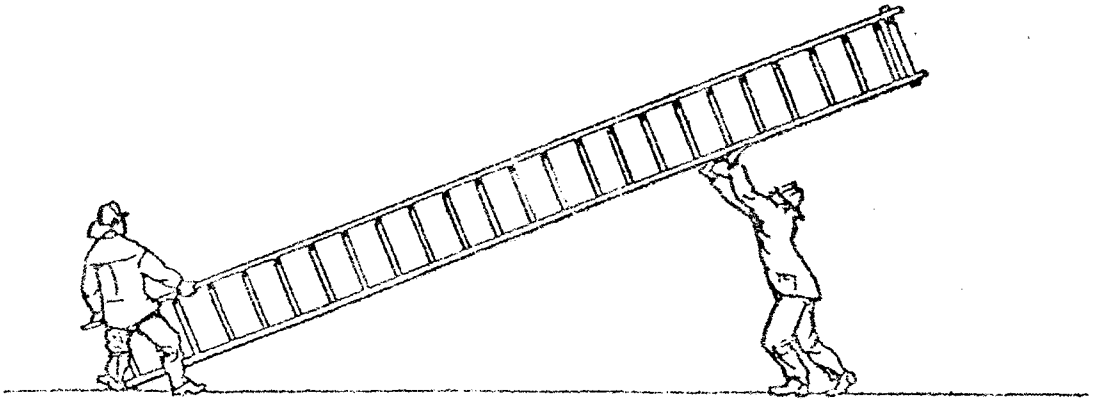
Two-Man Beam Raise

When the merits of both flat and beam raise are studied, their use generally becomes a matter of choice. It is the responsibility of the heel man to select the location for the raise, space the heel from the building, and determine if the ladder will be raised parallel or at right angles to the building.

The heel (butt) man places the lower beam at the selected location. He places his inside foot upon the lower beam at the heel, turns toward the ladder, and grasps the upper beam with his hands well apart. The other leg should extend well back to act as a counterweight and balance for his body.



TWO MEN BEAM RAISE
SHORT EXTENSION LADDER



TWO MEN BEAM RAISE - MEDIUM STRAIGHT LADDER

The beam man swings under the lower beam with extended arms. He then advances, hand-over-hand, down the beam toward the heel man raising the ladder until it is in the vertical position.

Both men face each other through the ladder and pivot the ladder if necessary. For proper control of the ladder during the pivot, it is necessary for the outside man to observe the top of the ladder. The beam man then places one foot on the bottom rung and both men lower the ladder gently to the building under the direction of the butt-man.

NOTE: In order to lower the straight ladder from the building to the ground, firefighters must reverse the steps of the operation they used to raise the ladder.

SHORT EXTENSION LADDERS

Carries and Raises

The length of two-section extension ladders is usually 24 feet, but the length of three-section extension ladders can be as much as 35 feet. It is possible for one man to carry a two-section extension ladder, but it is a rather cumbersome task. The one-man raise for the two section extension ladder is possible but it requires considerable physical stamina. An individual firefighter man, however, find it necessary to carry and raise this short extension ladder although it is more practical and safer for two men. For this reason, both two-men and one-man methods are described.

Carrying a Short Extension ladder (Two Men)

After the extension ladder is removed from the pumper the shoulder carry is preferred because of weight and bulkiness. Both men insert either their right or left arms between the beams and place the upper beam on their shoulder.

Raising Short Extension Ladder (Two Men)

It is the responsibility of the heel man to select the location for the raise, space the heel from the building, and determine if the ladder will be raised parallel or at right angles to the building. The heel man will give the commands in raising and lowering the ladder.

With both ladder beams flat on the ground (fly up) the heel man stands on the bottom rung or both beams, faces the ladder, and grasps a convenient rung from a crouching position. The beam man swings under the ladder with extended arms to make the raise.

The beam man advances, hand-over-hand, down the rungs raising the ladder to a vertical position.

If the ladder needs to be pivoted after it has reached the vertical position, the two men face each other through the ladder, hold both beams with extended arms tilt the ladder on one beam, and pivot the ladder around.

The heel man holds the ladder while the beam man raises and locks the fly. The beam man then places one foot upon the bottom rung and both men lower the ladder gently to the building.

Two Man Beam Raise

The heel man locates the lower heel plate at the desired place. He then places his foot upon the lower beam at he feel and grasps the upper beam with the hands well apart. The other leg should extend well back to act as a counterweight and balance. The beam man swings under the lower beam with extended arms. He then advances, hand-over-hand, down the beam toward the heel man raising the ladder to the vertical position.

Carrying Short Extension Ladders (One Man)

Low shoulder method: With the ladder on the pumper, face the ladder at the balance point. Place your right arm through and between two rungs and lift the ladder off the apparatus. Place the ladder on your shoulder and grasp the nearest rung with your right hand and the next rung with your left. Lower the front end slightly for the carry.

Raising the Short Extension Ladder (One Man)

Lower the ladder to the ground with the heel against the building. Stand at the top end of the ladder andface away from the building. Flex the knees and grasp the second rung from the top for the raise. Pivot under the ladder and walk toward the building while applying pressure to keep the heel against the building. Slide each hand down the beam to the next rung while progressing toward the building.

With the ladder flat against the building, grasp the 3rd rung from the bottom with one hand (palm up) and the 5th rung with the other hand (palm down) and move the elbow of the arm at the 3rd rung to brace against the lower abdomen and hip. Using the elbow against hip as a fulcrum, lift the ladder vertically and carry it to the proper distance from the building. With the ladder still in the vertical position, place one foot at the heel of one beam and, with the instep, knee, and leg, steady the ladder by the beam.

Watch the top of the ladder for balance, hold firmly to the halyard, and raise the fly section.

Place one foot on the lower rung, grasp two convenient rungs and lower the ladder into position.

Raising the Extension Ladder from the Low Shoulder carry.

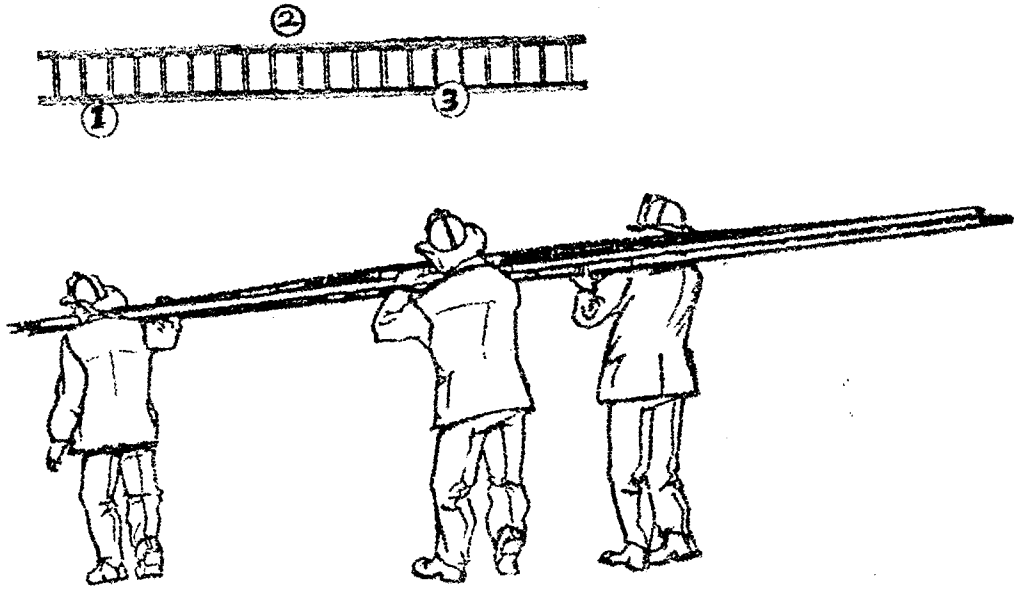
Grasp the rung next to the shoulder with the hand from the opposite side, slip the ladder partially from the shoulder, and grasp the next rung with the other hand. With these two control points on the rungs, lift the ladder upward in a flat position in front of the body and place the heel on the ground. Raise the ladder to a vertical position. The procedure for raising the fly section is as previously described in the one man raise from the ground.

MEDIUM LENGTH EXTENSION LADDERS
Carries and Raises

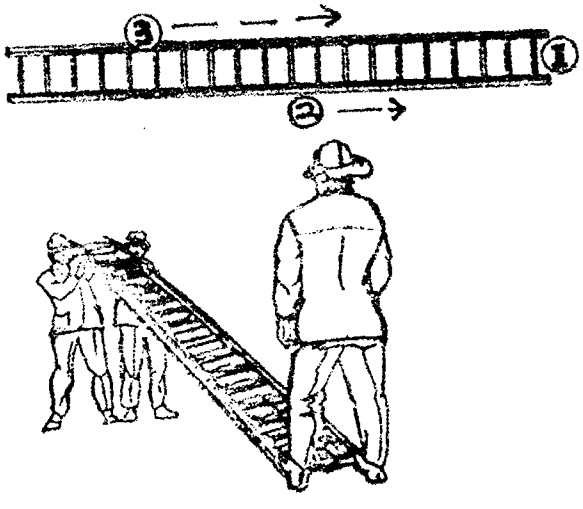
Removing Medium-Length Extension Ladders From Apparatus

Medium-length extension ladders are usually carried flat in the ladder bed and with the fly section on top. The heel plates are generally toward the rear of the apparatus so that this end of the ladder can be carried toward the place where it is to be used. The method of removing a medium-length extension ladder from the apparatus bed is as follows:

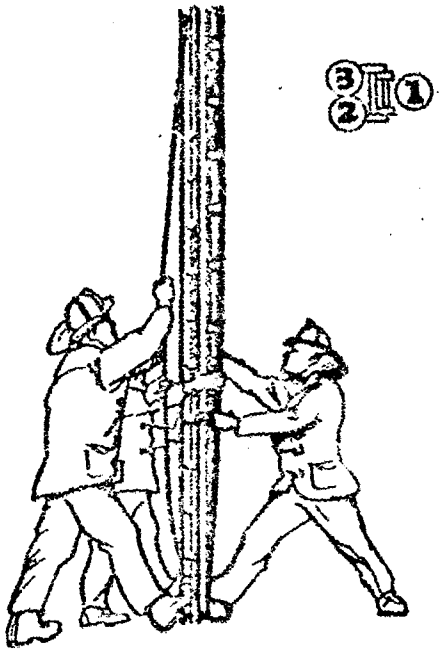
Three men are necessary for this operation. After the ladder locks have been released, the ladder should be pulled straight back from the ladder bed and in a level plane. The first man to advance the ladder should stand to one side and look over the area where the pull is to be made to be sure of safe footing. The pull should be uniform to prevent binding or tilting of the ladder. The second man should grasp the opposite side of the ladder at midpoint and assist the pull.



SHOULDER CARRY



THREE MEN RAISE



EXTEND FLY

The third man should stand on the same side as the first man and give a signal to stop when the ladder is about ready to leave the ladder bed. At this point, all three men lift the ladder from the apparatus for the carry.

Carrying the Medium-Length Extension Ladder (Three-Man)

The men carry the ladder flat with the beams of the bed ladder resting on their shoulders or they may carry the ladder at arm's length.

Shoulder Carry

After the ladder clears the apparatus, each man turns facing the heel of the ladder. The lead-off man should position himself a short distance from the heel, the second man on the opposite side at midpoint, and the third man at the other end and on the same side as the lead-off man. They then raise the ladder shoulder high and rest the beams of the bed ladder upon their shoulders.

Arm's Length Carry

After the ladder clears the apparatus, each man turns facing the heel of the ladder. From the same position described for the shoulder carry, each man grasps a convenient ladder beam and permits the ladder toswing in the flat position at arm's length.

Raising Medium-Length Extension Ladders (Three Men)

It is the responsibility of the man at the heel of the ladder (heel man) to select the location for the raise, space the heel from the building, and determine if the ladder will be raised parallel or at right angles to the building. Because of the positions of the men, it is more practical to place the ladder flat upon the ground before the raise so that raising positions can be assumed.

The heel man places both feet upon the lower rungs, and from a crouching position, grasps both beams with his hands.

The two beam men face the top of the ladder, and from a crouching position, grasp a rung or beam with their inside hands. The men lift and swing under their respective beams with their arms straight. They then advance, hand-over-hand, down the beams toward the vertical position.

After the ladder reaches the vertical position, it may may be pivoted. One of the beam men faces the heel man through the ladder while the other beam man pushes one beam off the ground. All three men walk with the pivot while the ladder turns. With the ladder in position, each man retains his respective position while the beam man in front of the ladder raises the fly section and locks the pawls.

The beam man in front of the ladder then steps upon the bottom rung and holds to a convenient rung while all three lower the ladder to the building.

EXTENSION LADDERS WITH POLES
Carries and Raises

Long extension ladders are usually equipped with poles to assist in raising, lowering, and stabilizing the ladder. These poles are called tormentor poles and they may be permanently attached to the ladder or they may be removable. Extension ladders with poles generally range from 40 to 60 feet in length and they may be raised either parallel or at right angles to a building. A building wall or some other object may alter the raise since the poles are required to be at right angles to each other after the ladder has reached the vertical position. Five men are generally used to handle extension ladders with poles. The beam men and pole men work in pairs while the heel man works alone.

Removing Extension Ladders with Poles from Apparatus (5 Men)

Extension ladders with poles are usually carried flat in the ladder bed with the fly section on top. The heel plates are generally toward the rear of the apparatus so that this end can be carried toward the place where it is to be used. The method of removing extension ladders with poles is as follows:

The first man to advance the ladder should look over the area where the pull is to be made to be sure of safe footing. After the ladder locks have been released the five men assume positions, three on one side and two on the other. They pull and pass the ladder straight back from the ladder bed and in a level plane. The pulls should be uniform to prevent binding or tilting of the ladder. The other men grasp the beams of the ladder as they spacethemselves during the pull. The man closest to the apparatus should give a signal to stop when the ladder is about ready to leave the ladder bed. At this point all men lift the ladder from the apparatus for the carry.

Carrying Extension Ladders With Poles (Shoulder Carry)

After the ladder clears the apparatus, each man turns facing the heel of the ladder. The three men on one side position themselves one at each end and the other at the center of the ladder. The two men on the other side position themselves midway between the center and end man respectively. They then raise the ladder shoulder high and rest the beams of the bed ladder upon their shoulders.

Arm's Length Carry

After the ladder clears the apparatus, each man turns facing the heel of the ladder. From the same positions described for the shoulder carry, each man grasps a convenient ladder beam and permits the ladder to swing in the flat position at arm's length.

It makes little difference whether the ladder is raised parallel or at right angles to a building, because it can alwasy be pivoted after it reaches the vertical position. It is the responsibility of the man at the heel fo the ladder, (heel man) to select the location for the raise, space the heel from the building, and determine if the raise shall be parallel or at right angles to the building. Because of the positions of the men and need for passing the poles, it is more practical to place the ladder flat upon the ground before the raise so that raising positions can be assumed.

Passing the Tormentor Poles

The heel man releases the poles from their keepers and raises them overhead at arm's length so that the beam men can grasp them. The beam men must alter their positions so that they can take the poles from the hell man. They walk toward the pole men, stationed a few feet from the top of the ladder, pass the poles directly overhead, and place them into the hands of the pole men.

Preparation for Raise

The heel man stands on the lower rung and, from a crouching position, grasps both beams with his hands. The two beam men face the top of the ladder and, from a crouching position below the tormentor swivel, grasp a rung or beam with both hands. The two pole men take their positions on the outside of the poles and face the top of the ladder. They should stand about five feet apart and hold the spur of the pole between the fingers of their inside hand.

The Raise

Raising an extension ladder with poles from a flat position on the ground to a vertical upright position is the most critical part of the raise. Once the ladder is lifted from the ground the movement of the raise should be continuous and without interruption of movement. Pauses, during this phase, tend to cause the top of the ladder to shift to one side.

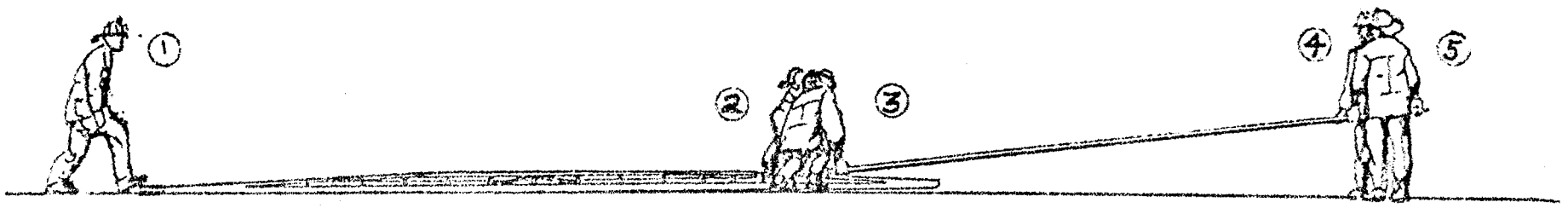
The beam men lift the top end of the ladder shoulder high, pivot under their respective beams, and advance, hand-over-hand, down the beam. The two pole men begin to take the ladder weight from the beam men when the ladder approaches and angle of about 45 degrees.

The pole man on the right moves to the inside of his pole and walks around to the right side of the ladder. The other pole man moves directly in front of the ladder. The beam man on the left moves to the left side to hold the ladder while the other beam man raises the fly section. Placing one pole man at one side and the other in front of the ladder provides four-way stability to the vertical ladder.

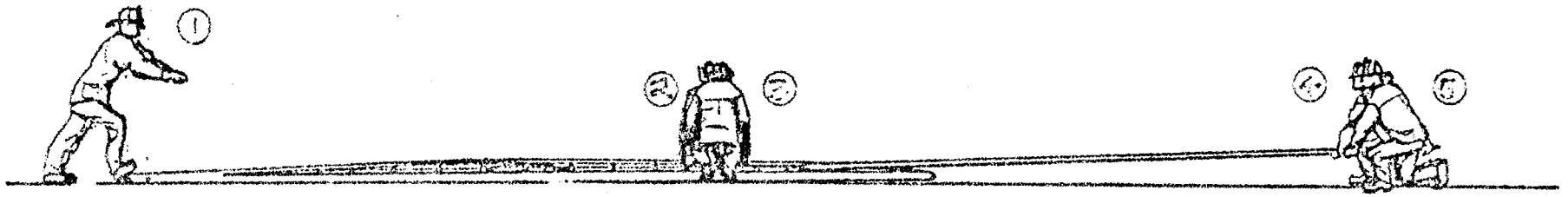
When the fly section reaches reaches the desired height, the side pole man orders the fly section to be locked in placed. The ladder is then lowered onto the building guided by the two pole men.

With the ladder in position the pole men place the poles parallel to the building at each side of the ladder. The poles must not be wedged against the ground and the ladder must have the natural sway.

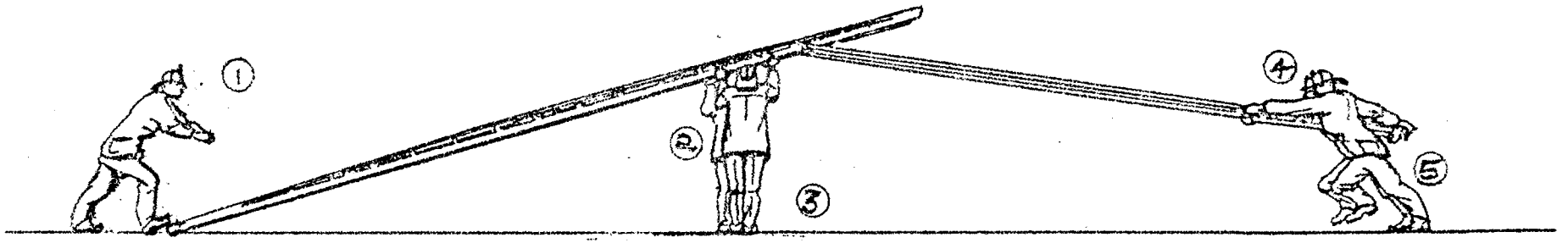
To lower the ladder, reverse the procedure.



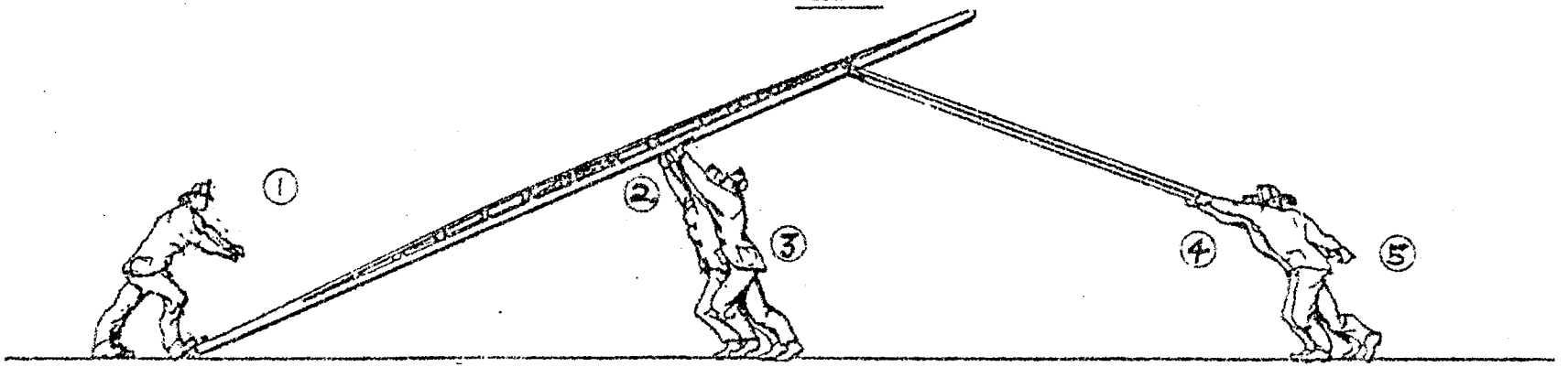
PLACEMENT OF POLES



PREPARE TO RAISE

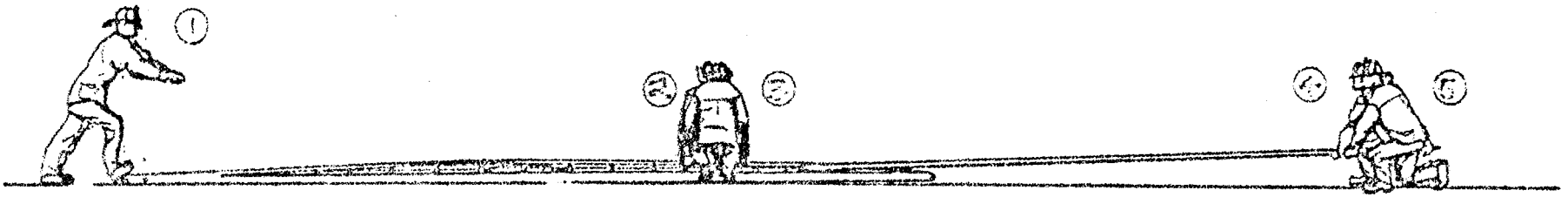


RAISE



50 FT. EXTENSION LADDER RAISE (5 MEN)

PLACEMENT OF POLES



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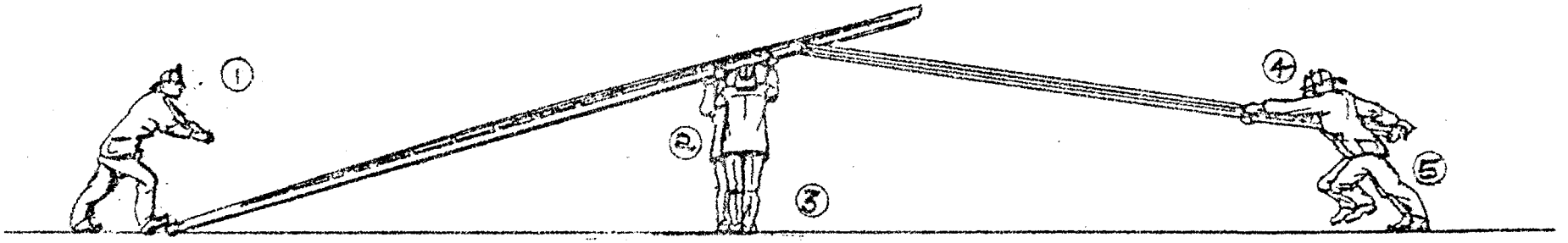

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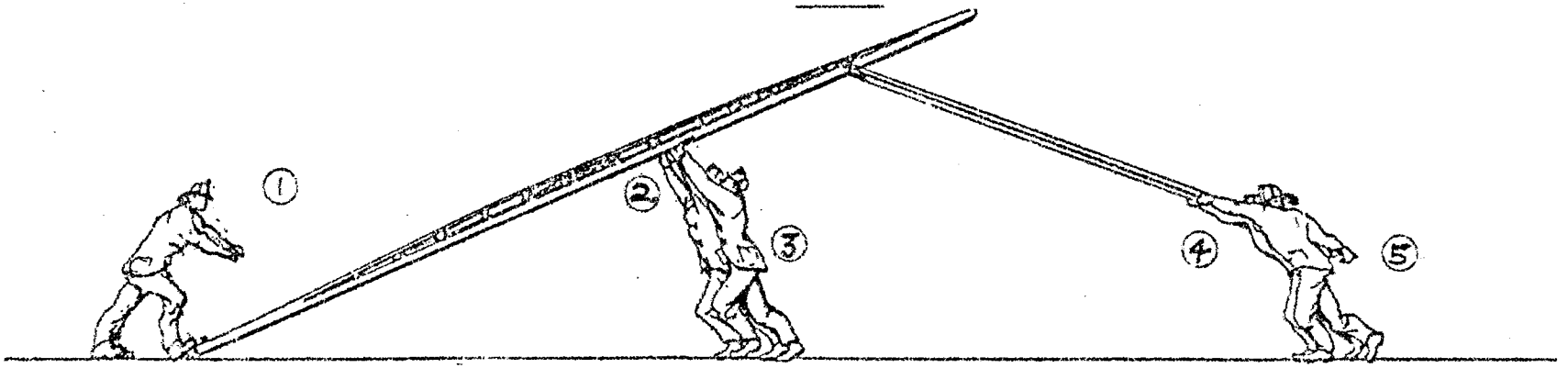
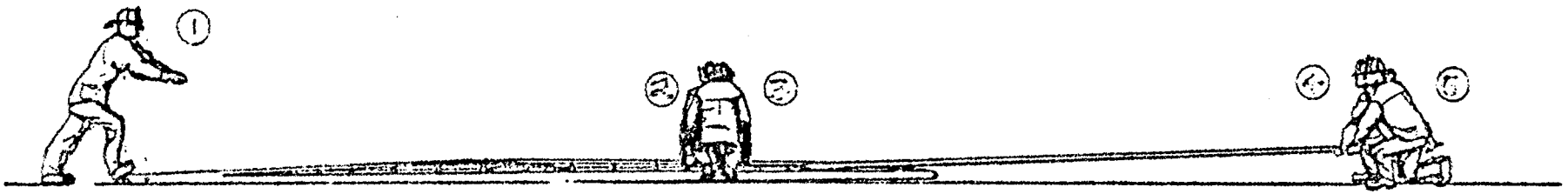


50 FT. EXTENSION LADDER RAISE (5 MEN)

PLACEMENT OF POLES



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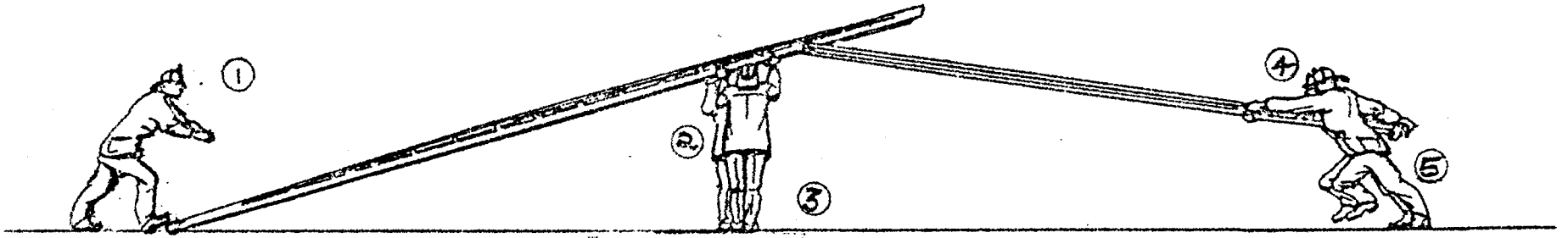
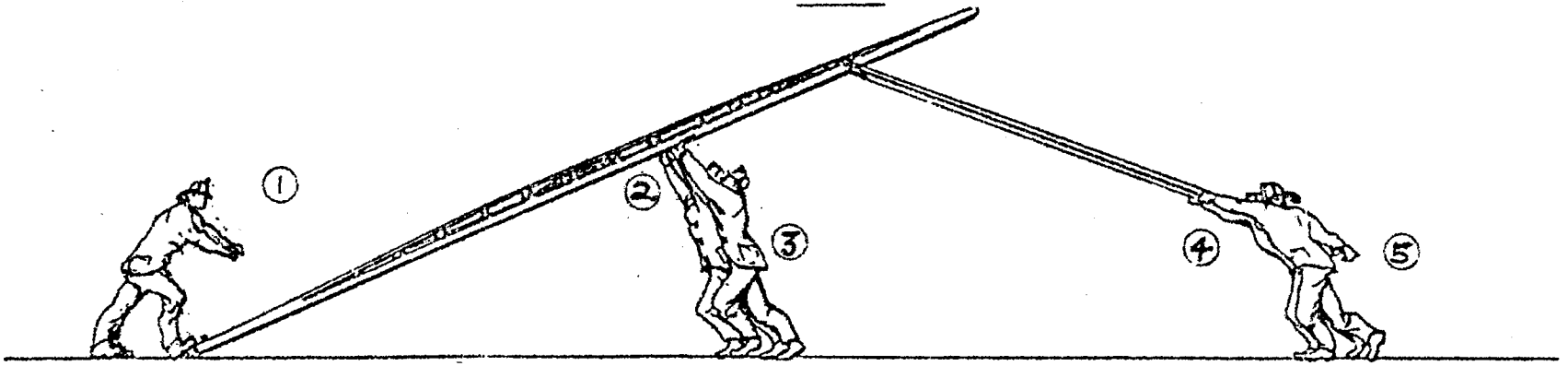
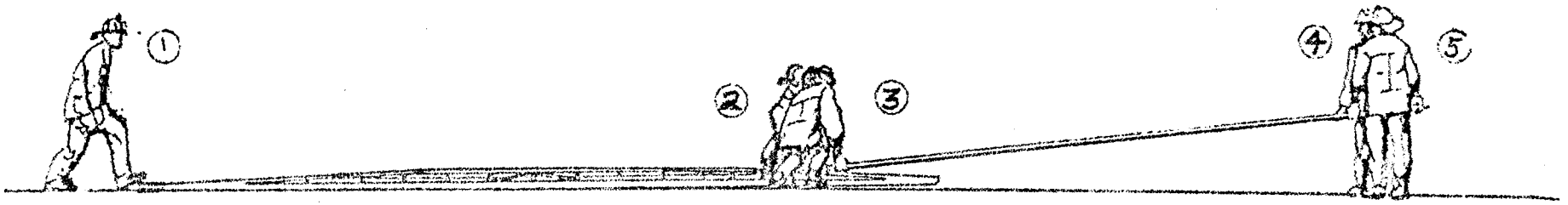


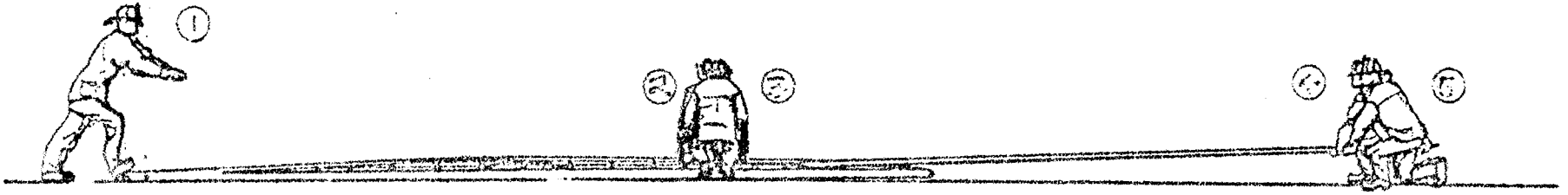
RAISE



50 FT. EXTENSION LADDER RAISE (5 MEN)



PLACEMENT OF POLES



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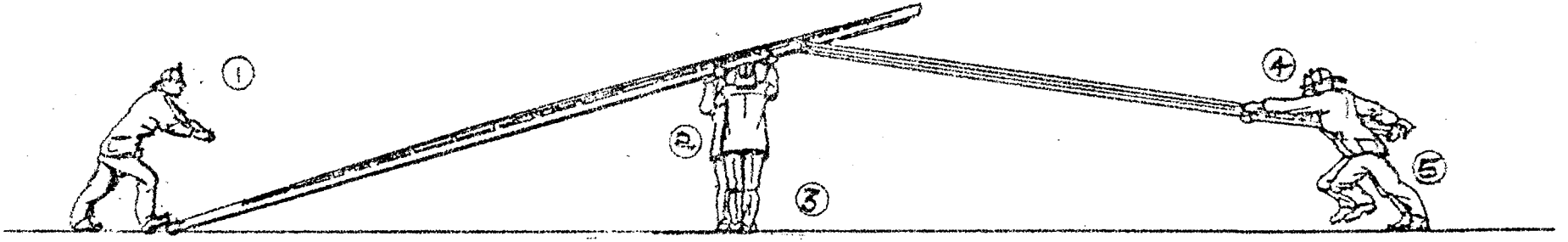

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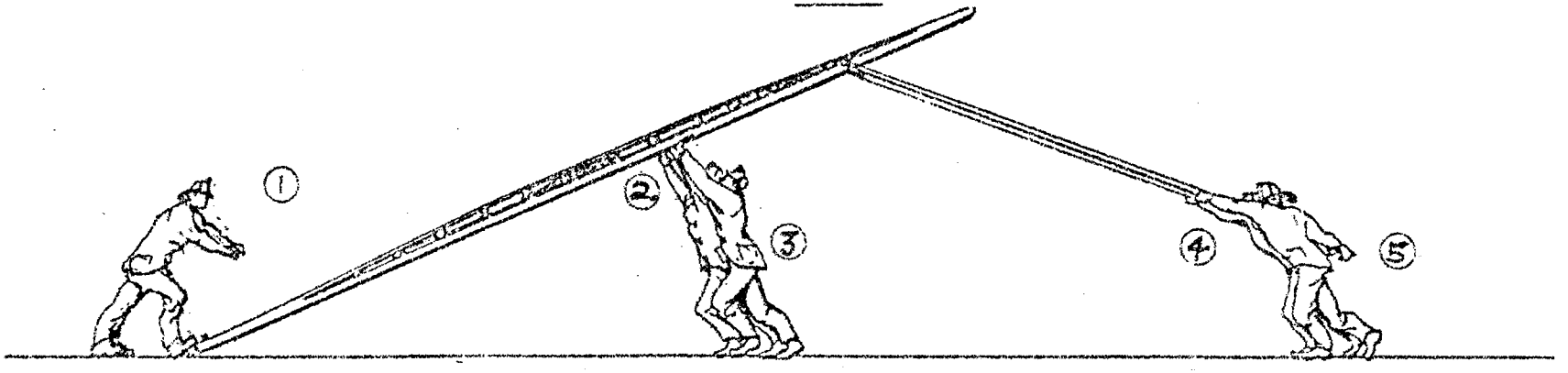
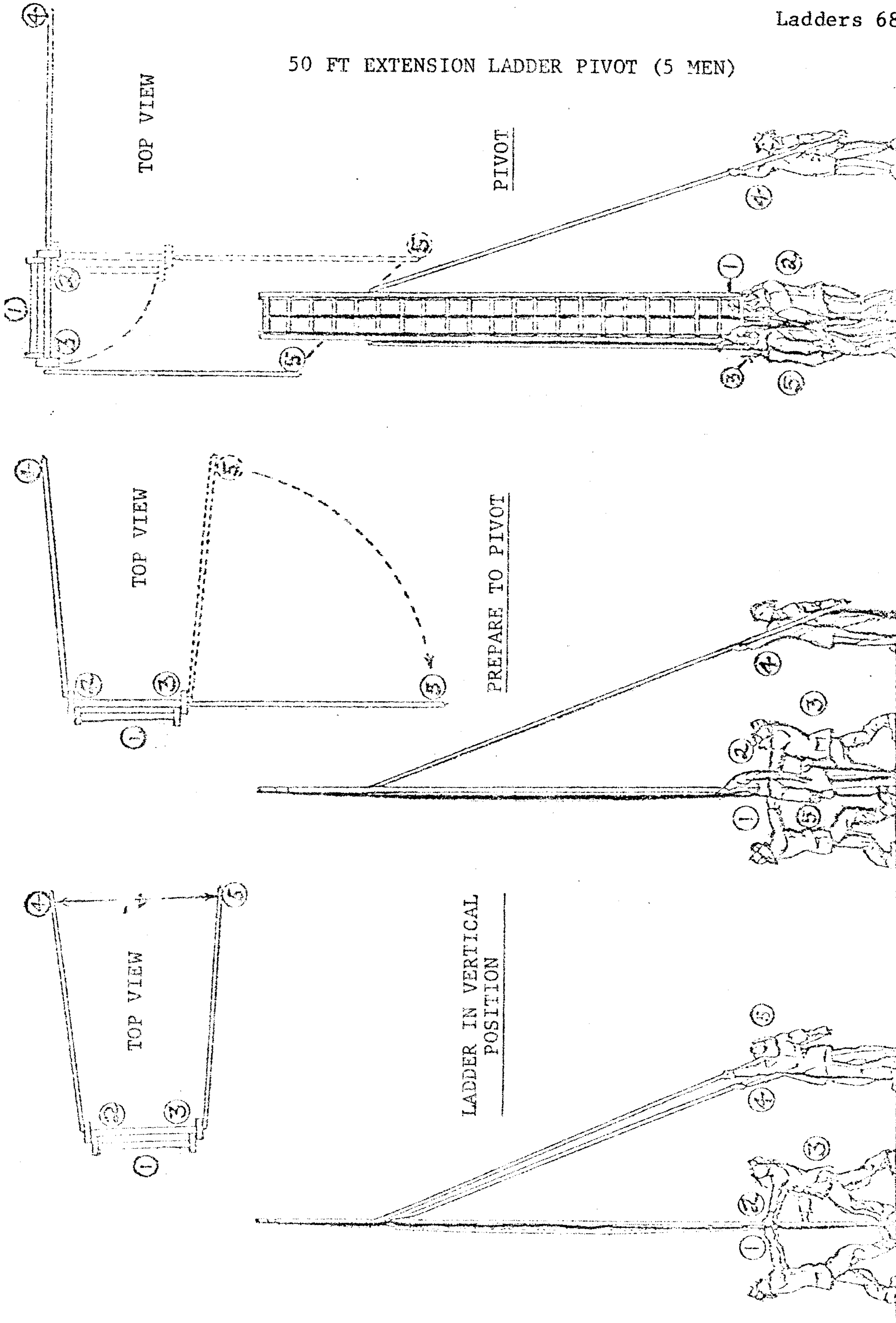
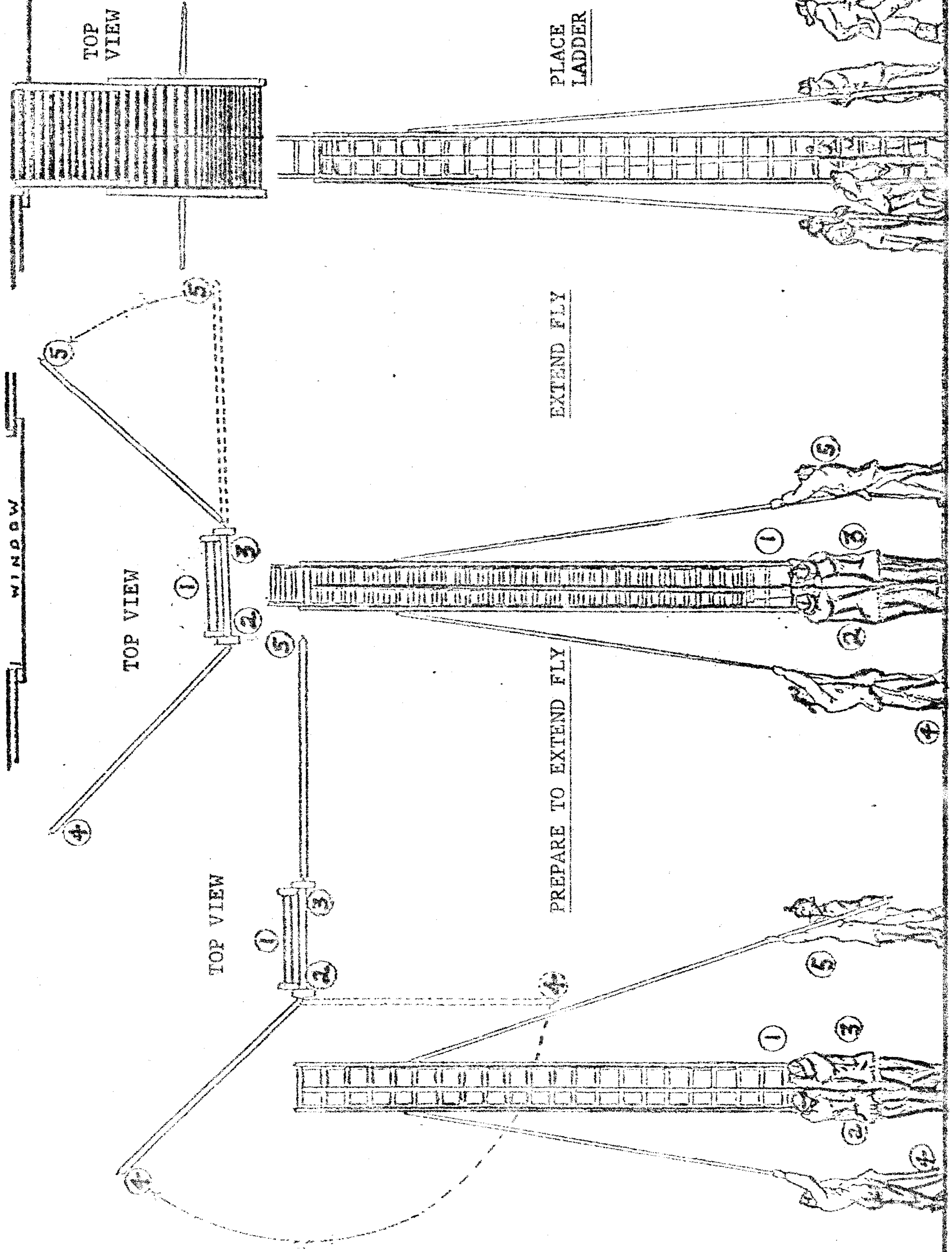


50 FT. EXTENSION LADDER RAISE (5 MEN)

50 FT EXTENSION LADDER PIVOT (5 MEN)



50 FT. EXTENSION LADDER WITH POLES (5 MEN)



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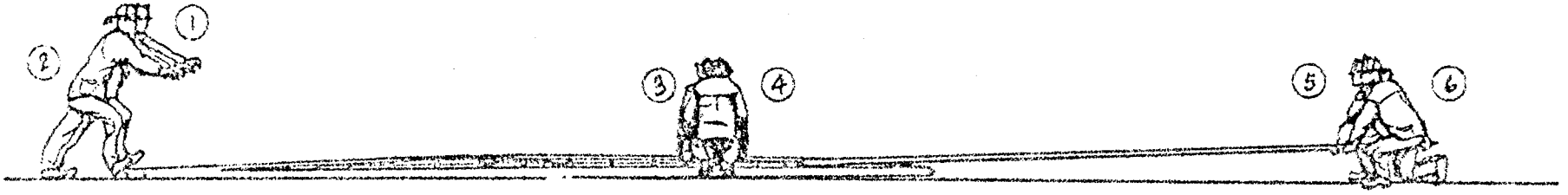

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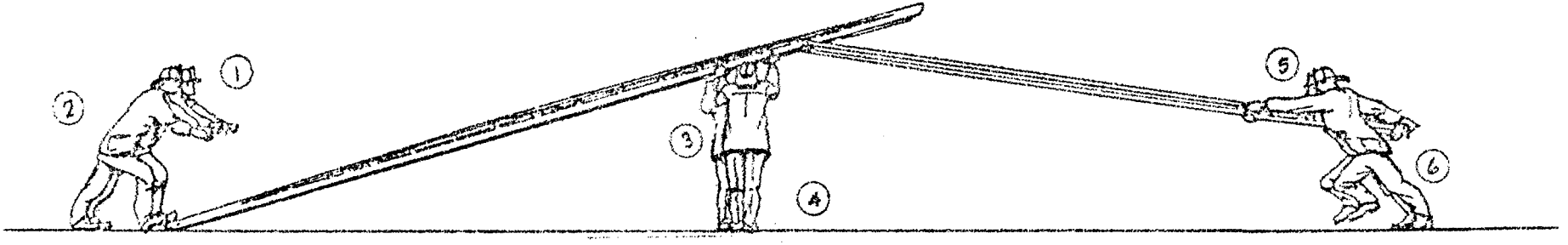

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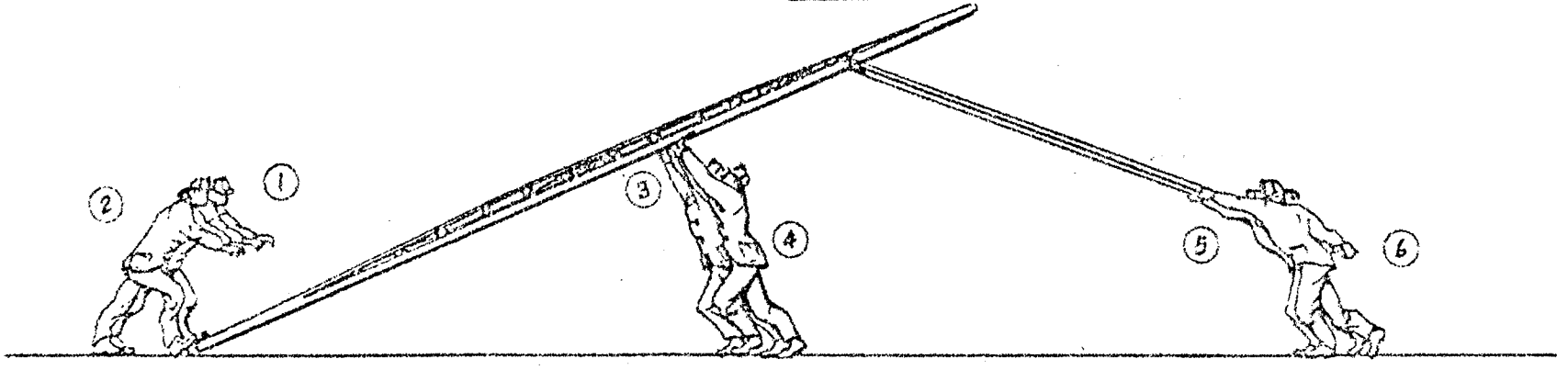
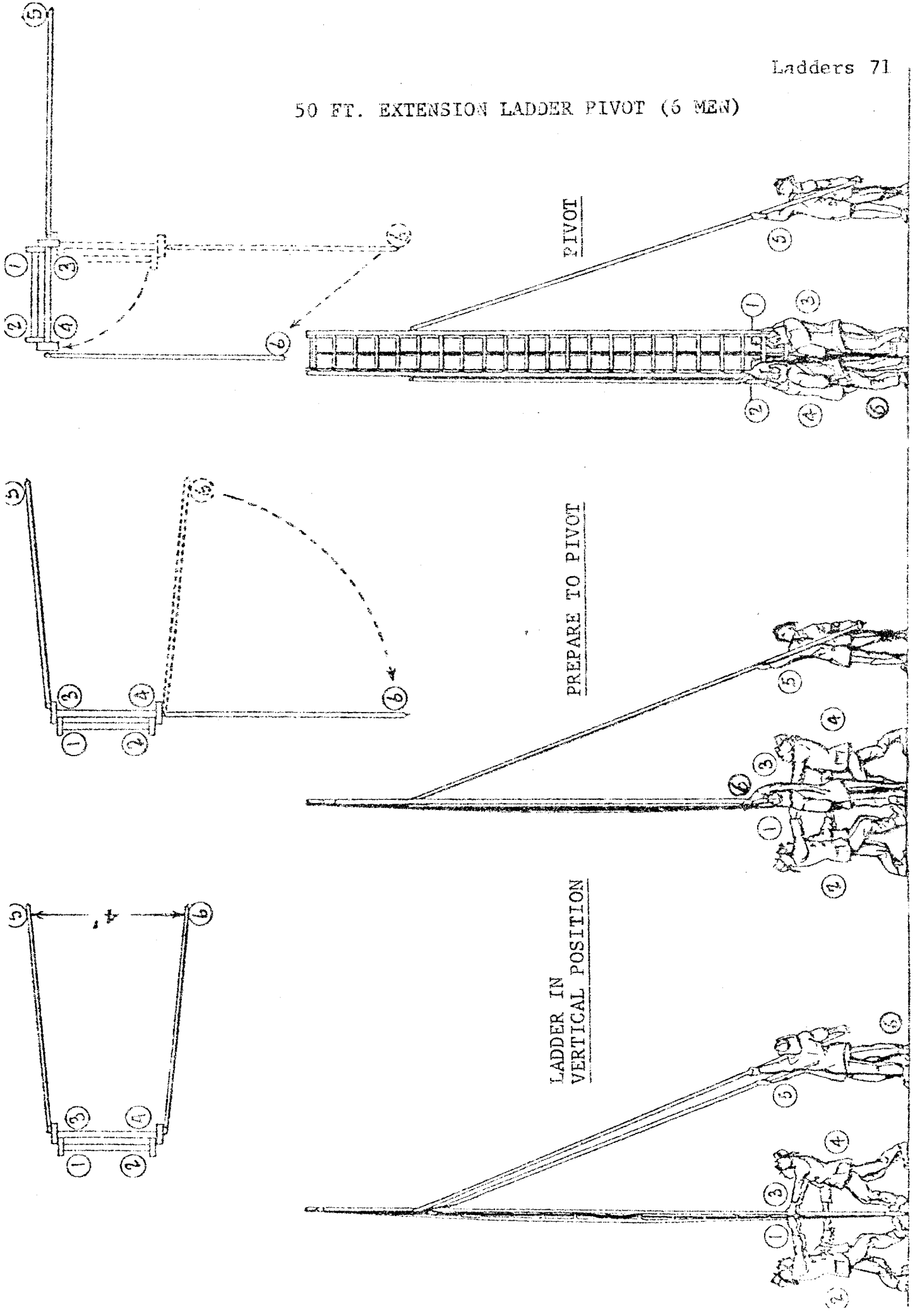
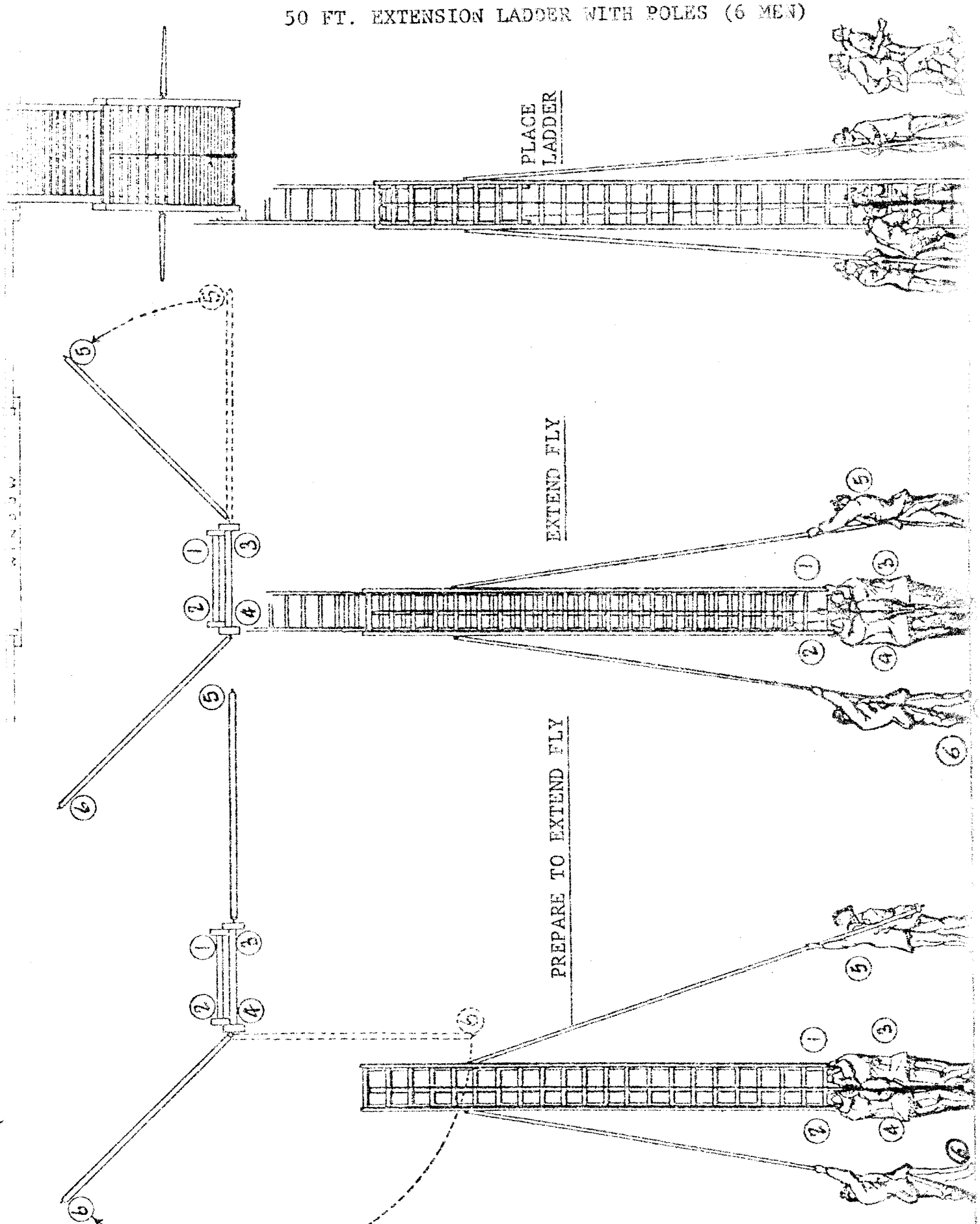


50 FT. EXTENSION LADDER RAISE (6 MEN)

50 FT. EXTENSION LADDER PIVOT (6 MEN)



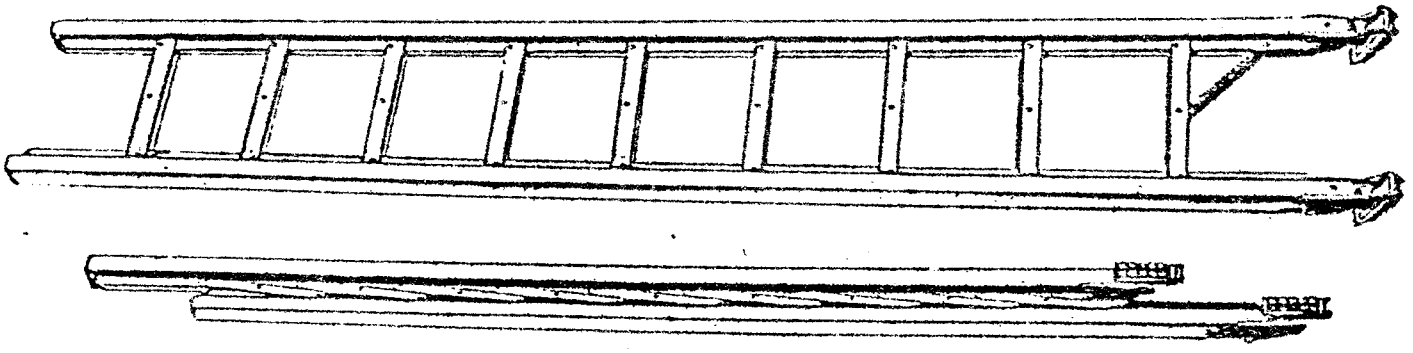
50 FT. EXTENSION LADDER WITH POLES (6 MEN)



Folding Ladders

The folding ladder is used inside buildings to gain access to that portion of the structure above the ceiling that is commonly called an attic or cockloft.

These ladders are constructed with two beams and the rungs are hinged to the beams with a single pin. This arrangement permits the rungs to be encased within the beams when the ladder is folded. The folding ladder is designed to be carried in the folded position so that it can be placed into small confined quarters before it is opened for use. To open the ladder, release any catch or lock and pull the beams apart until each beam rests firmly on the floor and the rungs are exposed.



Combination Extension Ladder

This small combination ladder may not be quite equal to the folding attic ladder, but its use in places other than ceiling openings makes it a very versatile ladder. This ladder consists of two short sections that are arranged like an extension ladder. It is short enough when not extended to stand upright in almost any doorway and it will extend to 10 or more feet, depending upon the length of the bed and fly section.

Because of its short length and small size, the combination ladder does not present a serious carrying problem. In most cases, it can be carried by one hand in the horizontal position. This small extension ladder can be placed into a vertical position directly below the attic opening and the fly section can be extended up through the opening to the desired height.

An additional feature that makes the ladder desirable is that it can be separated and jointed at the top to make a sturdy step or A-frame ladder. Recent models are equipped with safety locks to prevent the separated ends from spreading. Older models require the separated ends of the A-frame to be fastened together. A piece of rope or a rope hose tool is satisfactory for this purpose.

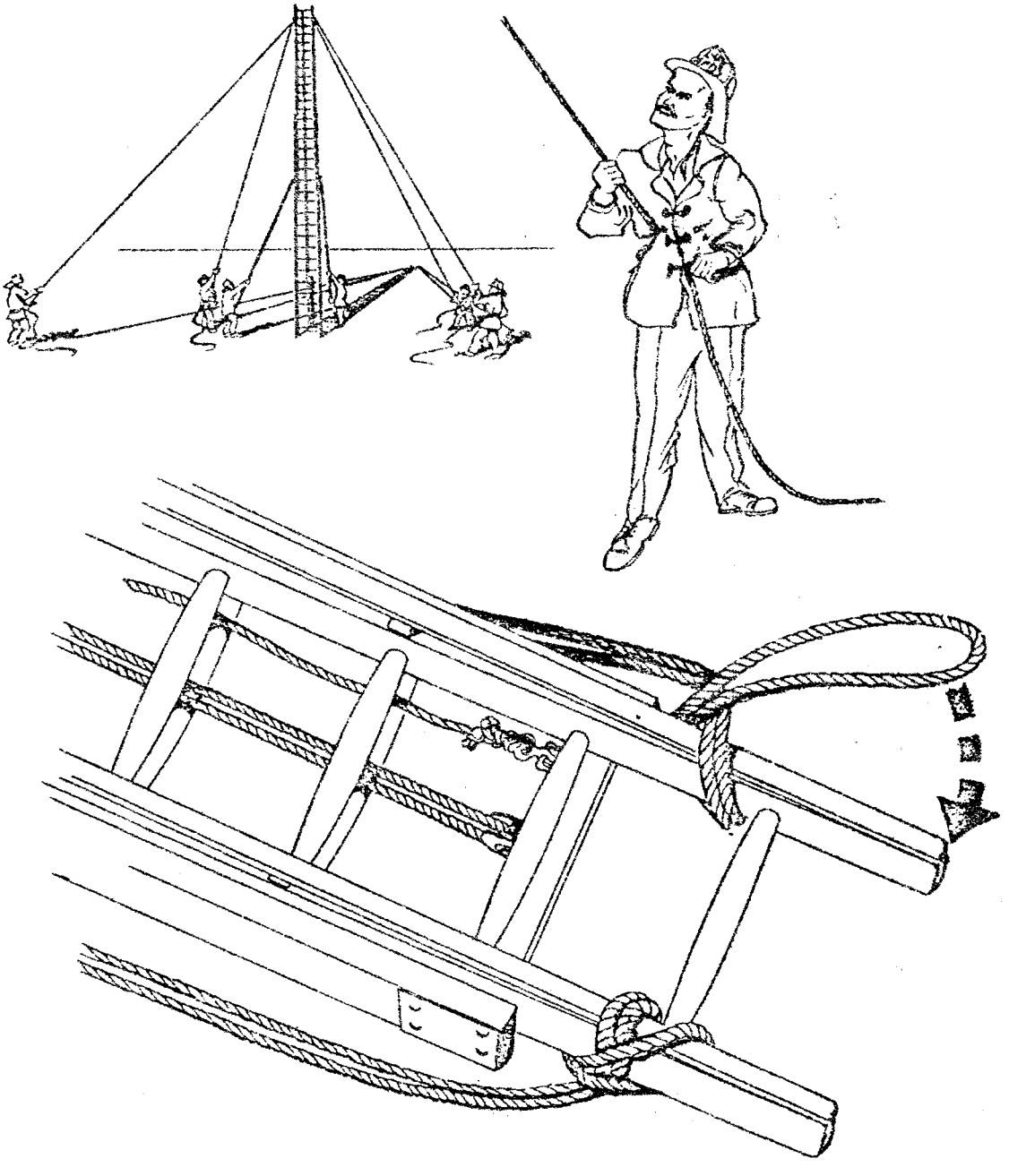
A Special Raise

The Church Raise (Dome Raise)

The church raise is a method of adapting a ground ladder to a condition where the top end cannot be supported. The top end of the fly section must be controlled by guy-ropes and considerable manpower is required. Precautions must be taken to insure that the ladder will be stable for the climber. Six men should be employed in the operation. Only one man wearing safety belt should climb the ladder.

Anchor men, at the end of each guy-rope, should hold the rope in his right hand, going behind the back at waist level and holding the bitter end in his left hand. The fly section should be extended a short distance and the guy-ropes should be applied before the ladder is raised. The ropes should be about 100 feet long for most extension ladders and ropes smaller than ½ inch should not be used.

The ladder may be raised to the vertical position by the standard method and, if the ladder is equipped with tormentor poles. they may be used to stabilize the ladder while the guy-ropes are placed into position. Before the raise is made, care must be taken to keep the guy-ropes from obstructing the movement of the ladder to the vertical position. Each end of the guy-ropes should be separated from the other ends and laid out to their respective sides. The guy-rope men feed out sufficient rope while the fly section of the ladder is raised to the desired height.



CHURCH RAISE

STANDPIPE AND HOSE SYSTEMS

Next to the Automatic Sprinkler Equipment, a well designed, properly equipped and reliably maintained standpipe system constitutes the best means for the extinguishment of fire in buildings. Each of these systems is capable of furnishing a class of service of which the other is incapable and, in most cases, they should be made to serve as complements to each other. The standpipe system provides the only reliable means for obtaining effective fire streams to the upper stories of tall buildings and supplying these streams in the shortest possible time.

Standpipe and hose systems provide readily all that is required for the class of service intended, such as:

1. For use by fire departments and others trained in handling heavy fire streams required during the more advanced stages of fire inside of buildings, or for exposure fires.

2. For use by the occupants of buildings as first aid fire protection, for the control of small fires by the occupants of buildings during working hours, and by watchmen and those present during the night time and holidays.

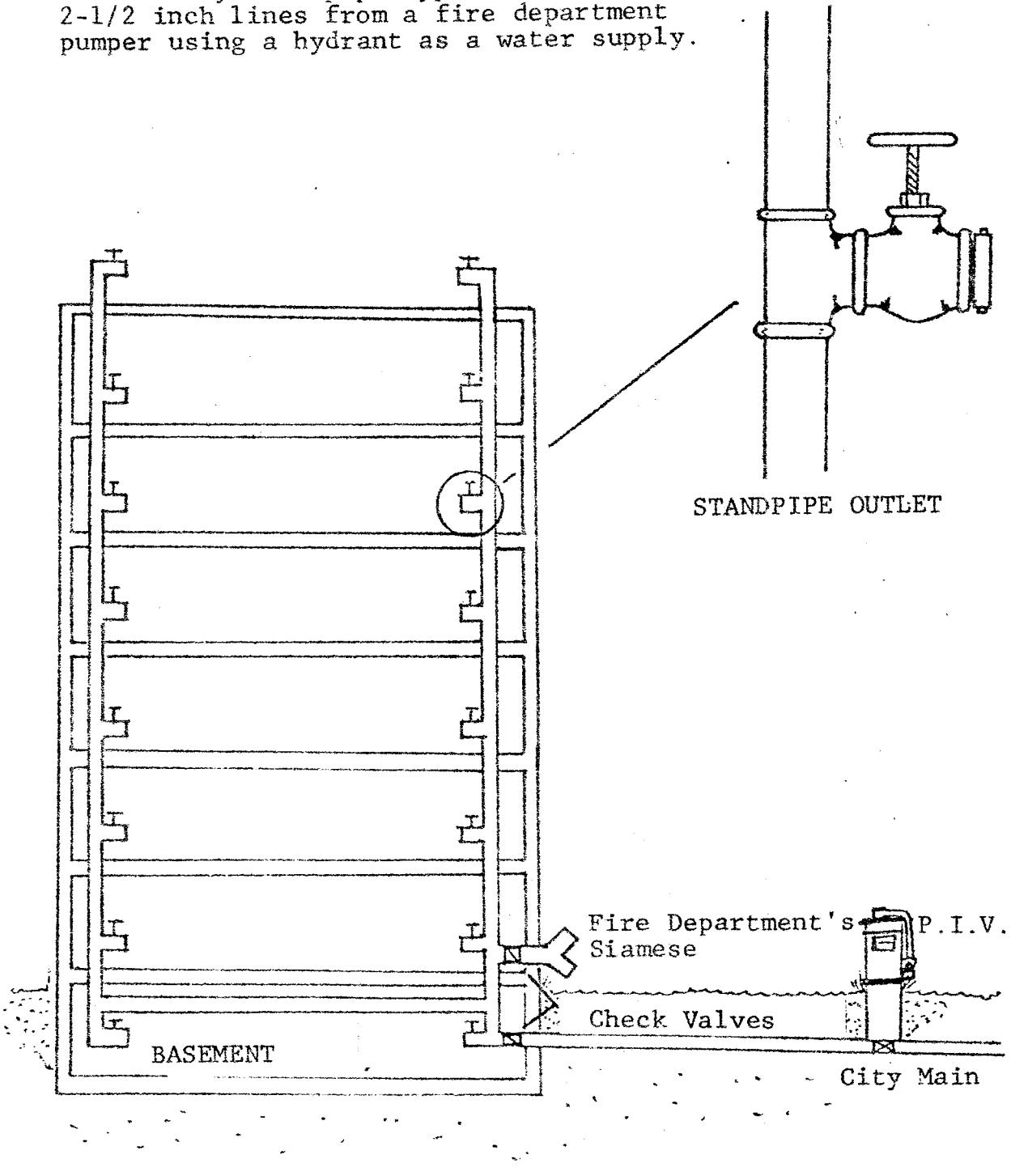
Standpipe systems are classified as follows:

1. Wet standpipe system having supply valve open and water pressure maintained at all times.

2. Dry standpipe system having no permanent water supply.

Simply described, a standpipe system consists of a fire department siamese connection located on the outside of the building and connected to one or more vertical risers which extend the height of the building -- oftentimes, to the roof. Interior standpipe risers should be located on an outside exit stairway. In either case, the standpipe should be provided with 2-1/2 inch valved outlets on each landing and on the roof. Some systems also incorporate hose cabinets, each of which should contain up to 100 feet of 1-1/2 inch hose equipped with a 3/8 inch or 1/2 inch nozzle. They are primarily for first aid firefighting by occupants of the building pending arrival of the fire department. Fire fighters often find it expedient to disconnect the house lines from these cabinets and connect their own heavier-duty fire hoses.

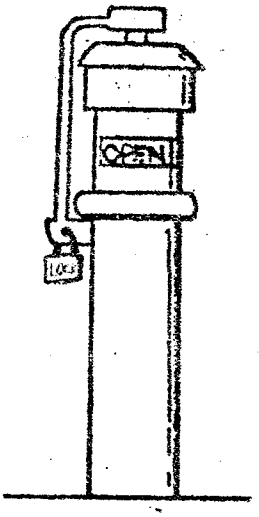
This type of system is rare; however, some do exit on Oahu. Most systems are the dry standpipe type fed by 2-1/2 inch lines from a fire department pumper using a hydrant as a water supply.

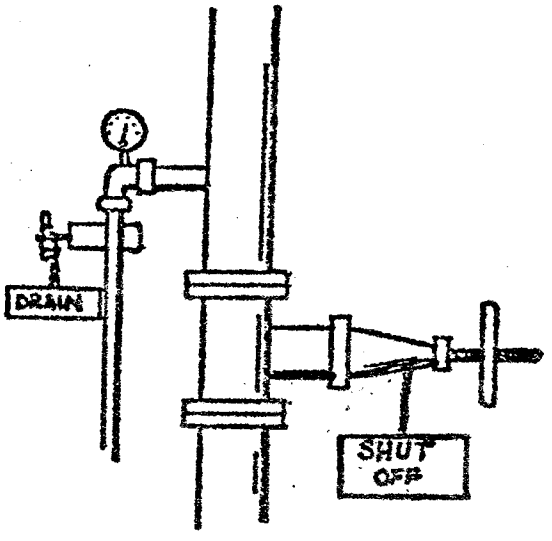


CONTROL VALVES

Control valves are also known as Post Indicating (P.I.), Stop, Outside Stem (screw) and Yoke (O.S. & Y.) and Gate Valves. Their purpose is to shut down the complete system, or to isolate parts of the system for repairs or testing purposes. They should be open at all other times. Some fire departments require that these valves be secured in the open position by means of a padlocked handle or chain so that they cannot be accidentally or maliciously closed.

Post Indicating Valves (P.I.V.'s) are generally located outside of the building at a distance of about 40 feet. Control valves known as Stop, O.S. & Y., or Gate Valves are usually located inside the building or outside the building near the bottom of the standpipe.

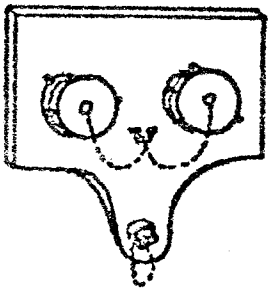




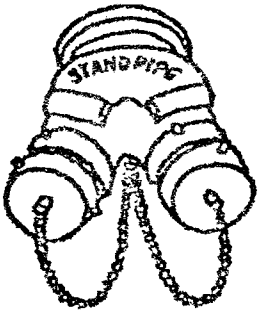
SIAMESE PUMPER CONNECTIONS

Siamese connections come in a variety of designs. Below are three commonly used connections.

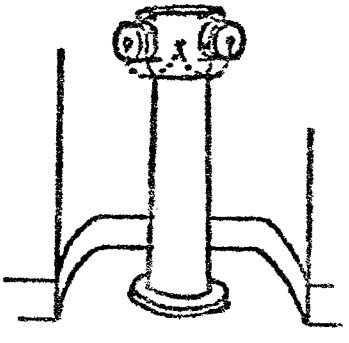
FLUSH



WYE



STANDING



A siamese connection may have two, three or four inlets depending upon the amount of water the system is designed to supply.

To protect their threads, the swivel-ends of the female couplings of siamese connections are provided with plugs or breakable plates. The plugs are either metal or plastic and are unscrewed with a hydrant or spanner wrench. The breakable plates are made of cast iron and are attached to the female coupling with two eye bolts running through the plate with the eyes looped over the lugs of the female coupling. A sharp hit with a spanner wrench will shatter the cap and the 2-1/2 inch hose can be connected.

Since the siamese connections for standpipe systems are identical in appearance to those for sprinkler systems, each connection should be provided with an iron or bronze sign with raised letters at least 1 inch high, to indicate its purpose.

Connecting to the Fire Department's siamese:

1. Read the identification plate to ensure that connection is being made to the proper system.

2. After removing the plugs or breaking out the protective plates, check for gaskets.

3. Check interior of siamese for foreign material..

4. Do not block unused inlets.

    a. If there are three or more inlets on a horizontal plane, connect first to the center.

    b. If inlets are located one above the other, connect to the lower one first.

Draining Dry Standpipes

After use, dry standpipe systems should be drained to relieve them of the weight of the water and to eliminate the possibility that an outlet may be opened which could result in water damage. It is necessary to drain standpipes to the level of the outlet on the floor immediately above the siamese connection for the standpipe system before draining at the siamese connection. This is to decrease the head pressure so that the clapper valves can be forced open without damage.

1. Connect a section of hose to the standpipe outlet on the floor immediately above the siamese connection. Place the male end of the hose in an area which is safe for water disposal.

2. Open the valve at that outlet.

3. Open the valve at the highest outlet to admit air.

4. When water has drained to the level of the outlet, force the clapper valve open at the siamese to complete drainage.

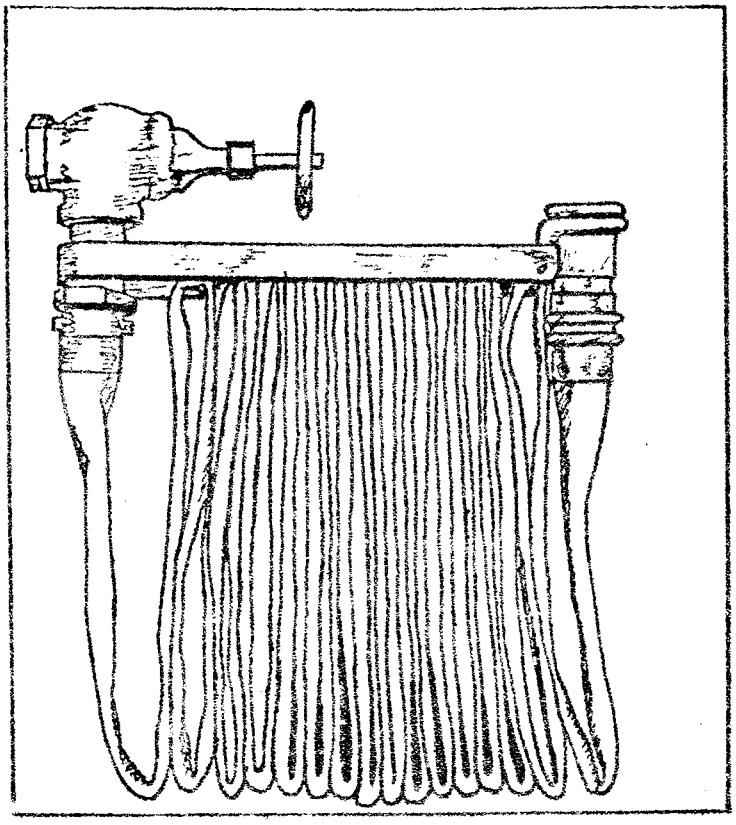
   Note: In order to prevent damage to clapper valves, which are usually made of brass, use a wooden implement such as a redwood plug or pike pole handle.

5. Close all outlet valves and replace all threaded caps and plugs.

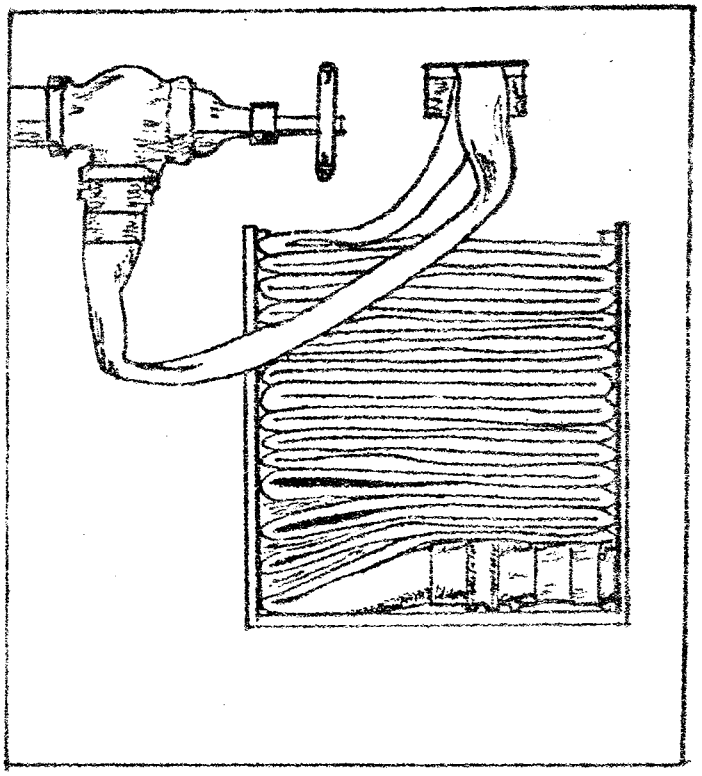
Types of Hose Racks

With hose racks of the "semi-automatic" or "one man" type, the hose valve should be opened fully. The nozzle should then be grasped firmly and the hose line drawn toward the fire. The water is automatically released as the last few feet of hose are pulled from the rack.

Where racks are of the non-automatic type, the services of two men are likely to be required. One man should grasp the nozzle firmly and draw the hose line toward the fire. When the hose is fully extended, the hose valve should be opened by the man stationed at the valve for the services required.



NON-AUTOMATIC HOSE RACK.



SEMI-AUTOMATIC OR
"ONE-MAN" HOSE RACK.

AUTOMATIC SPRINKLER SYSTEMS

An automatic sprinkler system can be defined as a network of specially sized piping installed in a building, generally at the ceilings, and to which sprinkler heads are connected and systematically spaced. It is connected to a suitable water supply through a control valve. Additional necessary components may include pumps, pressure gauges, check valves, gate valves, post indicator valves, and fire department siamese connections, all appropriately located according to design specifications.

In addition to all of the above, all sprinkler systems (except those specifically exempted by permission of the authority having jurisdiction) must be equipped with a water flow alarm. These alarm systems will be described in greater detail later in this chapter.

Sprinkler systems constitute the easiest and quickest means of getting water directly onto a fire. Most systems are designed to function automatically when a fire occurs, whether or not people are present or even know that a fire has started. Furthermore, sprinklers will operate under conditions of heat, smoke, noxious gases which make the area untenable for firefighters...even though they are equipped with the most modern safety clothing and breathing apparatus.

The automatic sprinkler is the most effective of all fire fighting tools. Fire records from 1925 to 1964 show that sprinkler systems operated satisfactorily in 96% of over 75,000 fires. The 4% failure was due to a variety of causes such as explosions which destroyed the system, freeze-ups, closed supply valves, failure of the water supply, etc. However, in recent years, the apparent percentage of satisfactory sprinkler operations has declined. From 1970 to 1974 it was 81%. This may be the result of the NFPA's data-gathering system which concentrates on those fires causing larger losses. Other studies that are based on approximately 100% reporting show considerably higher rates.

TYPES OF SYSTEMS

The six major classifications of sprinkler systems are:

1. Wet-Pipe Systems employ automatic sprinklers attached to a piping system containing water under pressure at all times. When a fire occurs, only those sprinkler heads affected by the heat will open. Water flows through them immediately.

2. Regular Dry-Pipe Systems have automatic sprinklers attached to piping containing air under pressure. When a sprinkler head is opened by heat from a fire, air pressure is reduced allowing a "dry-pipe valve" in the system to be opened by water pressure. Water then flows to any sprinkler heads which have opened. A dry-pipe system is installed only where a wet-pipe system is impractical, as in rooms or buildings which are not properly heated.

3. Pre-action Systems are dry-pipe systems in which the air in the piping may, or may not, be under pressure. When a fire occurs, those sprinkler heads affected by the heat will open. In addition, a supplementary heat detecting device in the area protected is actuated which opens a valve permitting water to flow into the piping and out of any automatic sprinkler heads which have been opened by heat of the fire. Pre-action systems are designed primarily to protect properties where there is danger of serious water damage as a result of damaged automatic sprinklers or broken piping.

4. Deluge Systems are similar to pre-action systems except that all sprinklers are open at all times. When heat from a fire actuates the fire detecting device, water flows to and is discharged from all sprinklers on the piping system, thus "deluging" the protected areas. Deluge systems are suitable for various extra hazard occupancies in which flammable liquids or rocket propellants are handled or stored, and where there is a possibility that fire may flash ahead of the operation of ordinary automatic sprinklers.

5. Combined Dry-Pipe and Pre-action System include the essential features of both types of systems. The piping system contains air under pressure. A supplementary heat detecting device opens the water valve and an air exhauster at the end of the feed main. The system then fills with water and operates as a wet-pipe system. If the supplementary heat detecting system should fail, the system will operate as a conventional dry-pipe system.

6. Limited Water Supply Systems use automatic sprinklers and follow the standard piping and spacing arrangements, but are supplied by a pressure tank of limited water capacity. Limited water supply systems are used where a public water supply or other conventional type of supply, such as a gravity tank or fire pump, is not available for sprinklers with sufficient volume or pressure to satisfy the water supply requirements in the NFPA Sprinkler Standard.

There are other "Special Types" of sprinkler systems, some of which are:

1. Outside Sprinkler System is a water curtain discharged through a open sprinkler system in a fan-shaped pattern. The controlling valve is a deluge valve operated by a heat responsive system having thermostats spaced at specific intervals.

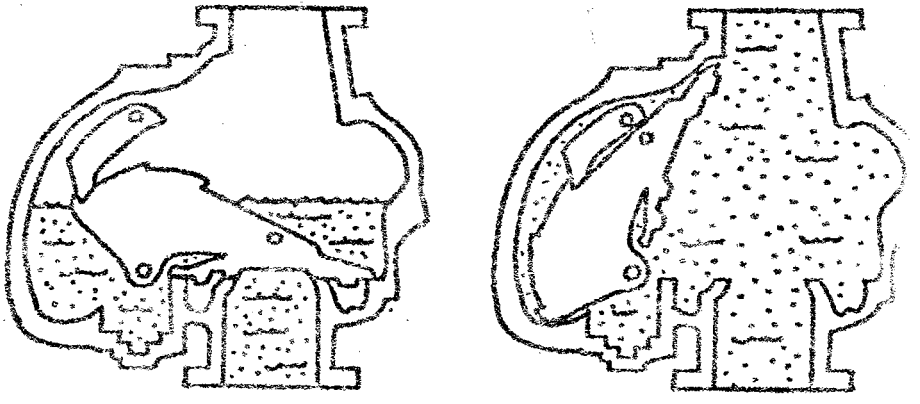
2. Chemical Type System in which the tank pressure is produced by a soda-acid reaction. Although no longer available for new installations, they were suitable for installation in light hazard occupancies where two or three sprinklers and a limited amount of extinguishing liquid could be expected to extinguish or hold a fire in check.

3. Cycling Sprinklers are a recent development by the sprinkler industry. It is a sprinkler that cycles "on" and "off" as needed and operates on a pilot valve principle. Under normal conditions, the pilot valve is held closed by the snap disc. Water in the piston chamber holds the piston closed. When the snap disc is heated to 165 degrees Fahrenheit, it opens the pilot valve and releases the water from the piston chamber. This allows the piston to open and water to flow from the sprinkler. When the snap disc cools to 100 degrees Fahrenheit, it closes the pilot valve. Water enters the piston chamber through a restricted orifice in the piston, and the difference in pressure forces closes the valve. The sprinkler is ready for repeated operation should the snap disc be again heated to 165 degrees Fahrenheit. Both a pendent and a recessed model are available.

Of these six classifications, the Wet-pipe system represents about 75% of the total installations while the Dry-Pipe system is the next most common type. The Dry-pipe system is used mainly in locations where temperatures are low and freezing of a wet system may occur. The Dry-Pipe system is not as effective as the Wet-pipe system because it operates more slowly due to the delay caused by air having to escape from the system before water can flow to the sprinkler heads.

DRY-PIPE VALVE:

Before and after operation



THE N.F.P.A. SPRINKLER STANDARD

N.F.P.A. Standard #13, "The Standard for the Installation of Sprinkler Systems" outlines the planning and design of sprinkler protection, the type of materials and components used in these systems, and the installation. Compliance with N.F.P.A. #13 is often required by enforcement agencies, insurance companies and insurance inspection and rating bureaus such as the A.I.A.

The aforementioned agencies may also require that devices and equipment used in sprinkler systems be approved by a recognized testing laboratory. Among the laboratories recognized by the authorities having jurisdiction are: Underwriters' Laboratories, Inc. and Factory Mututal Engineering Corporation.

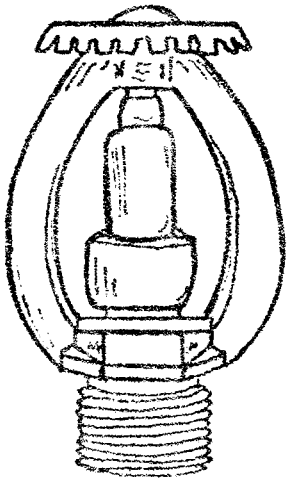
OPERATING PRINCIPLES

The discharge of water from an automatic sprinkler is restrained under normal conditions by a cap or valve held tightly against the orifice by a system of levers and links pressing down on the cap and anchored firmly in place by struts braced against the frame of the head.

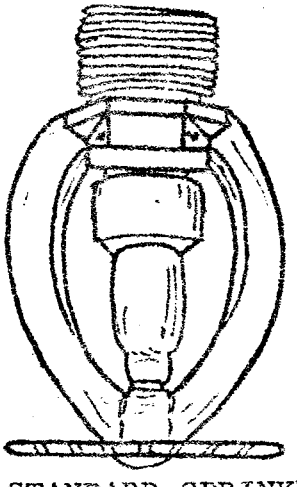
A sprinkler may incorporate one of three different types of activating devices: the frangible bulb, the frangible pellet, or the fusible link. (Frangible means easily breakable while fusible means capable of being liquefied by heat.)

Another important component of the sprinkler head is the deflector or distributor. Due to the design of the deflector, water issuing from the orifice in a straight stream under pressure strikes the deflector and is converted into a coarse spray, designed to cover or protect a certain area. The pattern is roughly that of a half-sphere filled with spray.

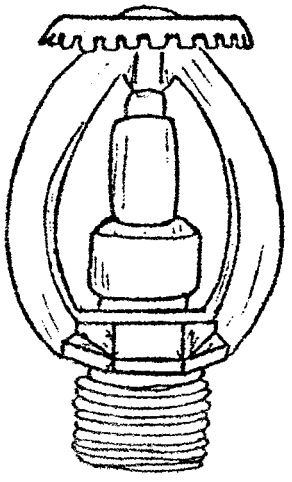
Although there are many designs and models of sprinkler heads, they can be grouped into two basic categories: those which are installed on the piping in an upright position, and those installed in a pendent or hanging position. Sprinklers must be installed in accordance with the stamping on the deflector bearing the appropriate words or letters: SSU (Standard Sprinkler Upright) or SSP (Standard Sprinkler Pendent).



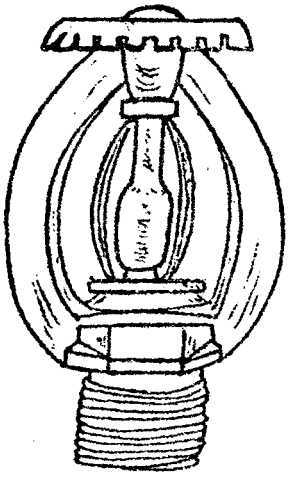
STANDARD SPRINKLER
UPRIGHT



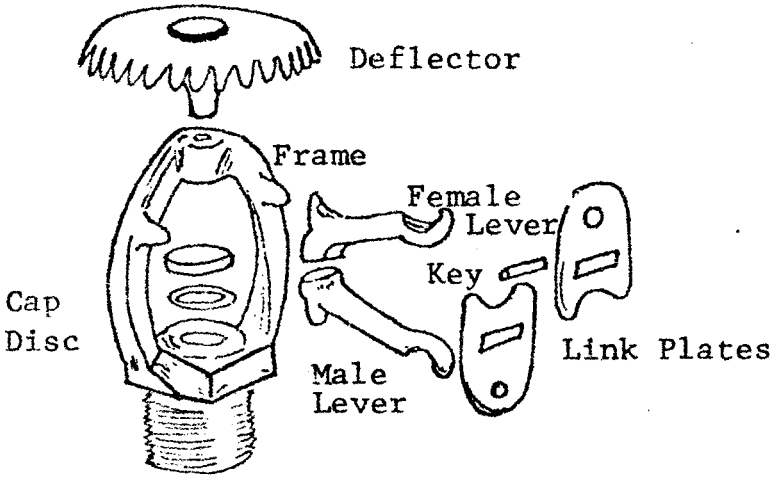
STANDARD SPRINKLER
PENDENT



FRANGIBLE BULB

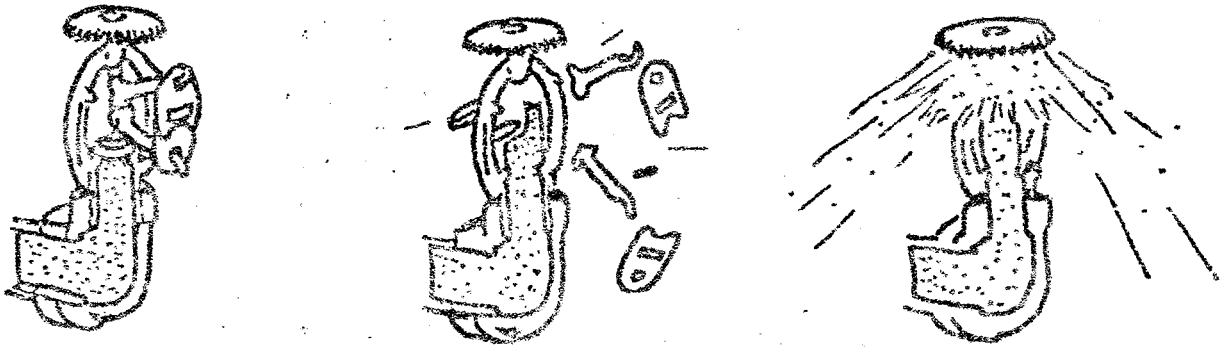


FRANGIBLE PELLET

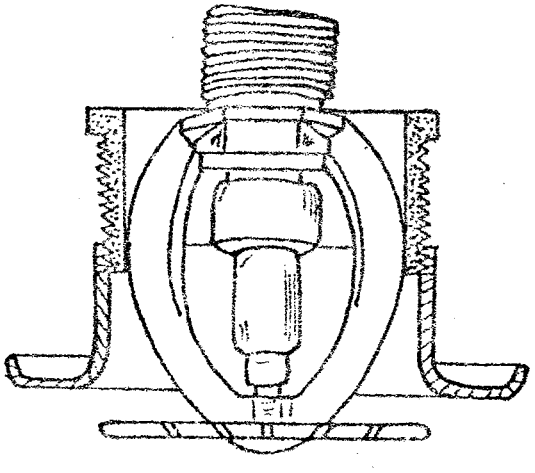


FUSIBLE LINK

The most widely used device is the fusible link which operates on the principle of the fusing of a metal alloy of a predetermined melting point. When the temperature of the room reaches the predetermined melting point of the fusible link, it melts and allows the mechanical parts holding the cap over the orifice to fall out. Water pressure forces the cap off and is then discharged over the fire.



There is another type of head which is, in essence, a pendent type head. These are called ceiling-type or flush-type sprinkler heads. They are used in areas where appearance is of prime importance. They are installed flush against the ceiling and are hardly noticeable. These heads have the same water discharge rate and pattern as a standard pendent sprinkler.



TEMPERATURE RATINGS OF SPRINKLER HEADS

Automatic sprinkler heads have various temperature ratings which are derived from standardized tests. The operating temperature of all fusible link heads is stamped on the link. Temperatures are given in degrees fahrenheit.

Sprinkler heads are color coded to indicate their ratings.

CODE	RATING	OPERATING TEMPERATURE
Bronze	Ordinary	135-165 Deg.
White	Intermediate	175-212 Deg.
Blue	High	250-286 Deg.
Red	Extra High	325-360 Deg.
Green	Very Extra High	400-415 Deg.
Orange	Ultra High	450-500 Deg.

Some determining factors in the selection of the proper sprinkler head are:

1. Type and construction of occupancy
2. Process carried on in the occupancy
3. Anticipation of a rapidly developing fire
4. Anticipation of a rapid rate of rise in temperature
5. Normal ambient temperature of the room

WATER-FLOW ALARMS AND SPRINKLER SYSTEM SUPERVISION:

Water-flow alarm devices have been used to some extent since automatic sprinklers were first installed, however, since 1951 the N.F.P.A. Sprinkler Standard has advised sprinkler alarms on all sprinkler systems except at the discretion of the approving authority.

Water-flow alarm devices are designed and adjusted to give an alarm if a water flow, equal to the discharge of one or more sprinkler heads occurs in the system.

They work by means of a check valve which lifts from it's seat when water begins to flow in the system. The movement of the valve is used to admit water to an alarm giving device such as a water-motor driven gong or the movement of the valve may be used to mechanically trip an electric switch which activates an electric gong, horn, or siren.

Sprinkler systems are usually required to have an approved water-motor driven gong, or an electric gong, horn or siren on the outside of the sprinklered building. An electric bell or other audible signal device may be located inside the building. A sign is usually provided near the outdoor alarm which is worked as follows: "Sprinkler Fire Alarm - When Alarm Sounds, Call Fire Department."

LOCATION AND SPACING OF SPRINKLERS

The N.F.P.A. Sprinkler Standard outlines definite maximum areas of coverage for each sprinkler head in a system and also maximum distances between sprinkler heads. These standards are based, for the most part, on the severity of the occupancy hazard. Refer to N.F.P.A. Standard #13.

CONTROL VALVES

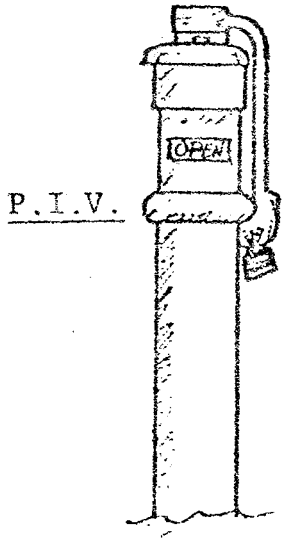
Post Indicator Valve (P.I.V.)

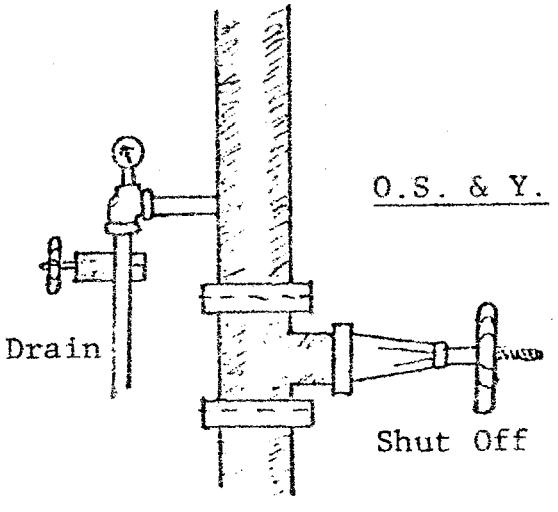
Where sprinklers are supplied from a water main service outside the building, an approved outside post indicator valve will generally be found at a safe distance from the building. The glass windows at the top of the post indicator valve will show the word "open" when the valve is properly set to allow a maximum amount of water to flow into the system from the city main.

Outside Screw and Yoke Valve (O.S. & Y.)

Another type of control valve is the approved outside screw and yoke valve commonly referred to as the O.S. & Y. valve. When an O.S. & Y. valve shows maximum length of the threaded stem, the valve is wide open to permit a maximum amount of water to flow into the system.

Refer to NFPA Fire Protection Handbook, Section 16 for more information on sprinkler system control valves. Specific information on O. S. & Y. and P.I. valves can be found in Section 13, pages 68-72.





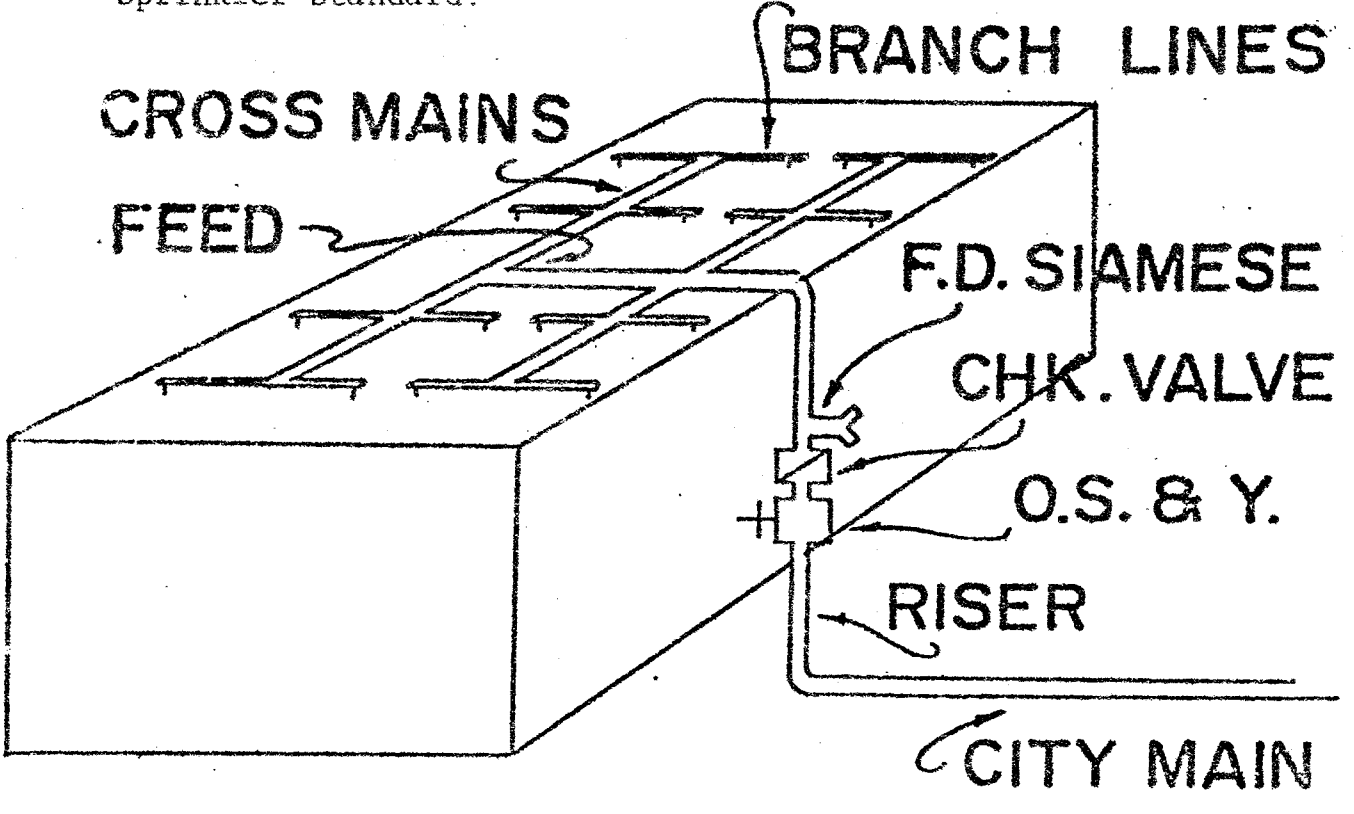
SPRINKLER PIPING

Sprinkler piping must be carefully planned and installed in accordance with the N.F.P.A. Sprinkler Standard. These piping arrangements are very similar to public water systems and some of the nomenclature used in both systems are the same.

There are four principal components in a piping arrangement:

1. Risers - vertical pipes bringing water from public mains to the ceilings of sprinklered areas.
2. Feed Mains - pipes which supply water from the top of a riser to a cross main.
3. Cross Mains - pipes directly supplying branch lines.
4. Branch Lines - pipes on which sprinkler heads are placed.

As in the case of sprinkler spacing and location, the size of piping in sprinkler systems and the maximum number of heads it is allowed to supply are outlined in the N.F.P.A. Sprinkler Standard.



FIREGROUND PROCEDURES

Sprinkler systems are usually provided with two or more 2½ inch female inlet connections, equipped with clapper valves near the street or ground level. Female swivels and threads are protected by plugs. Inlet connections are manifolded and and arranged either vertically, horizontally or as a cluster. Pressure on sprinkler systems may be increased by lines laid from pumpers and connected to the inlet manifolds of the systems.

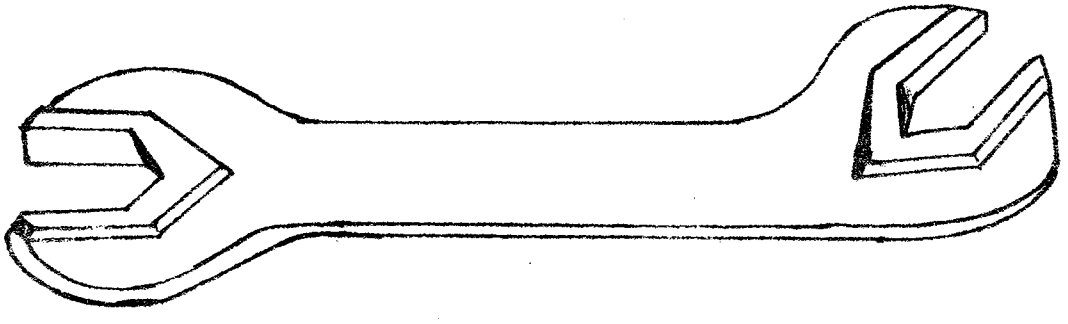
Two or more 2½ inch lines should be connected to inlet manifolds of sprinkler systems when it becomes necessary to increase the pressure. Avoid blocking unused inlets when connecting lines to manifolds. This usually necessitates connecting center or lower inlets first.

Standard Triple Combination Engine Companies.

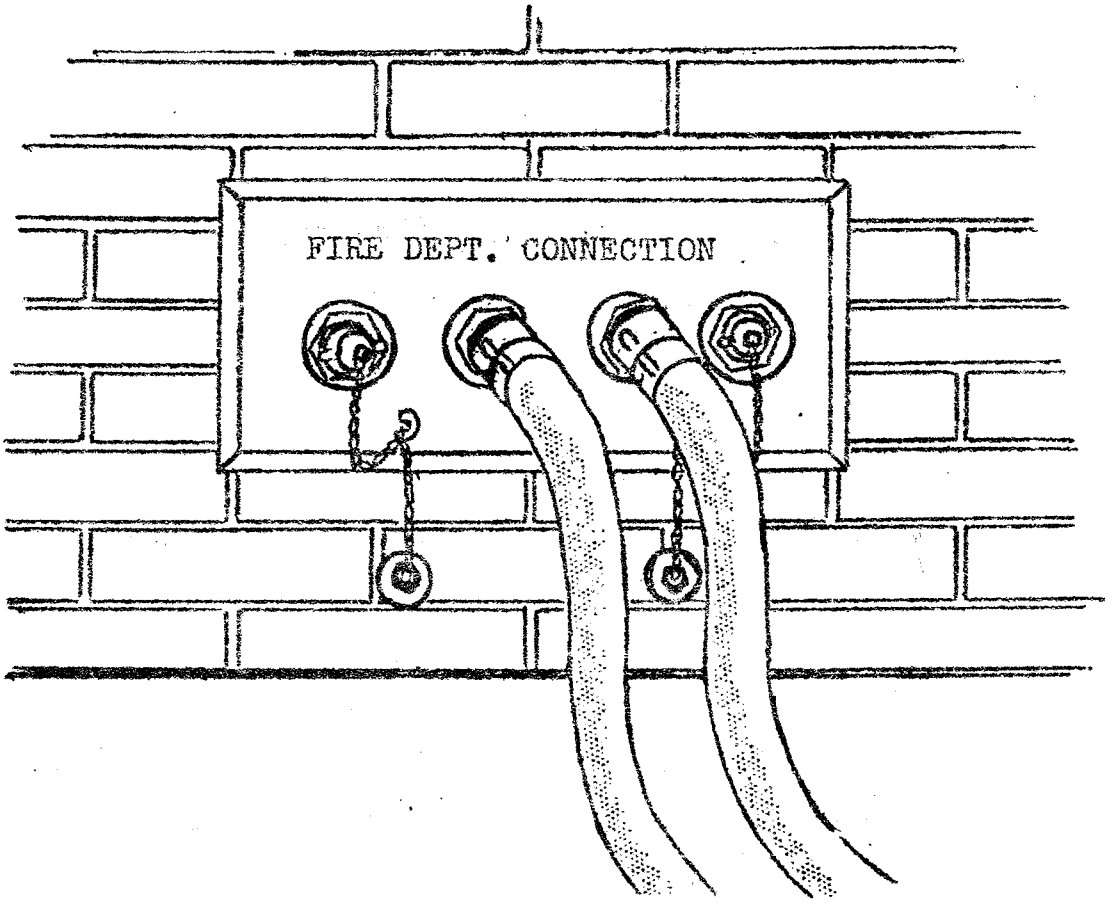
1. Lay two 2½ inch lines to inlet manifolds of sprinkler systems.
2. Remove protector plugs of lower or center inlet manifold connections; check gaskets; check inlets for foreign material.
3. Connect butts to female inlet connections (spanner tight).
4. Connect additional line or lines, in the same manner; avoid blocking unused inlets.

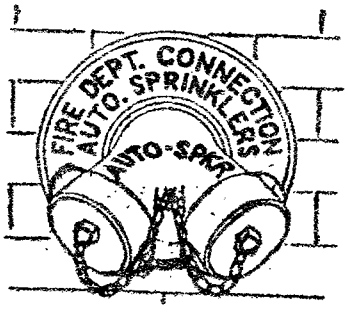
After the Fire.

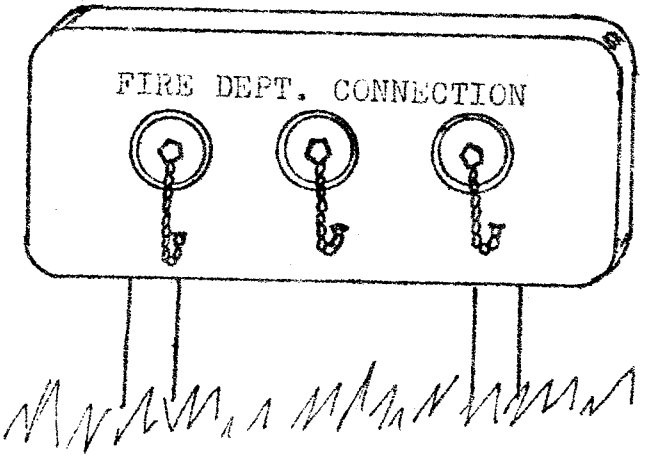
1. Close the riser control valve. This valve is usually the O.S. & Y. valve.
2. Drain the system involved by means of the drain valve located at the sprinkler-riser.
3. Replace (or have management replace) all fused sprinkler heads and equipment, and reset the dry valve if any.



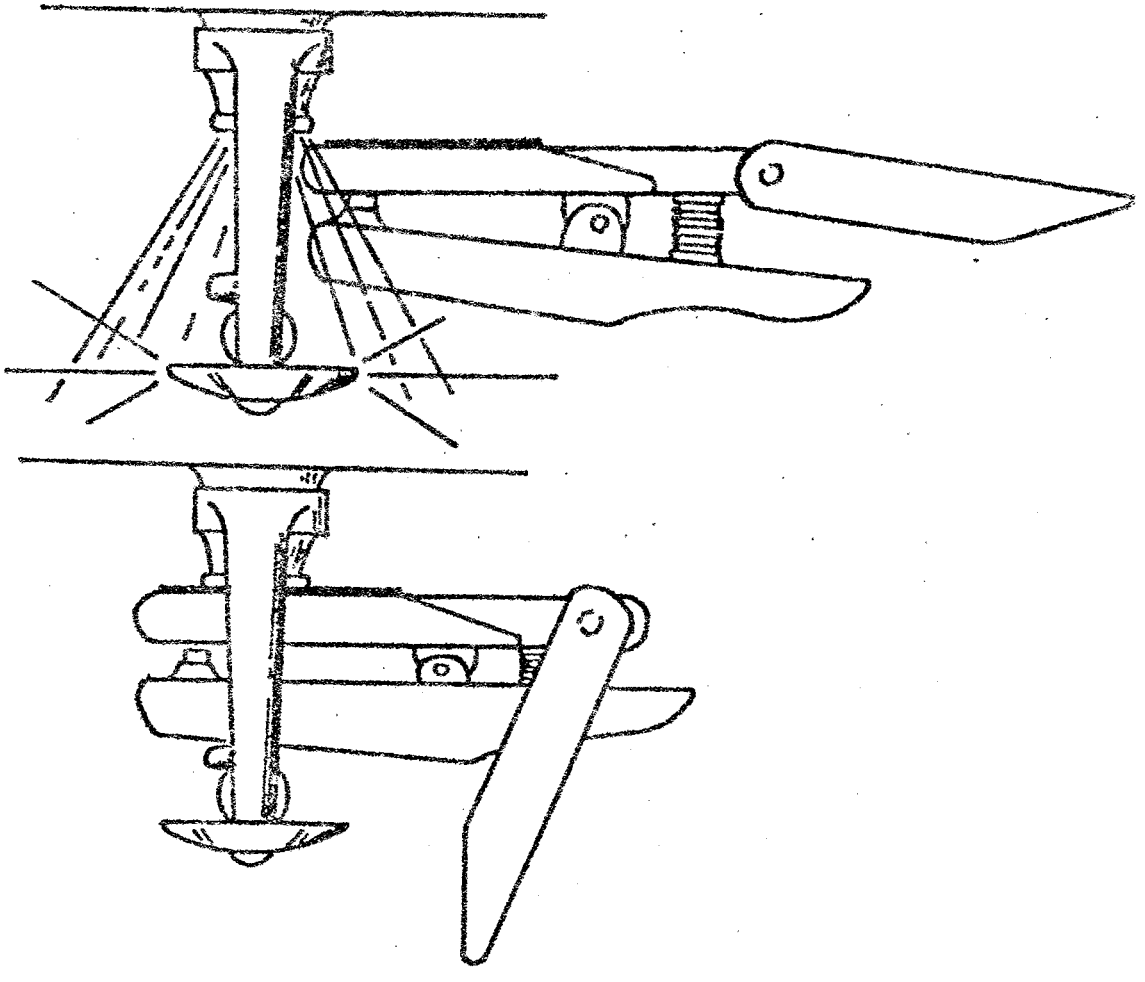
SPRINKLER HEAD WRENCH


FIRE DEPT. CONNECTION


FIRE DEPT. CONNECTION
AUTO. SPRINKLERS
AUTO-SPKR


FIRE DEPT. CONNECTION

When only a few sprinkler heads have fused (which is usually the case) each individual head may be shut off by use of a device known as a "sprinkler head shut-off". It is good practice to equip each apparatus with several of these. The type most common to Honolulu Fire Department is the "Quickfit" clamp. The Quickfit clamp is provided with an elastic pad on one surface which is forced against the discharge opening thus forming a water tight seal. Before leaving the premises, fire fighters should ensure that the system is put back in operating condition by closing the control valve, replacing all fused heads, and reopening the control valve.



FORCIBLE ENTRY

Basic firefighting strategy requires the firefighters to locate the seat of the fire rather than to automatically apply water to the building which would likely "push" the fire toward unburned areas. Entry into burning buildings is the first step to properly combat a fire. Frequently, entry is blocked and the firefighter must resort to the use of tools and imaginative forcible entry techniques. The opening of these areas where natural openings are locked, blocked or where openings are not provided is considered to be "Forcible Entry." The firefighter is required to gain entrance before rescue or performing ventilation, investigation or fire suppression can be accomplished. A skillful method of forcible entry will aid in the saving of lives, cause less damage to property, and result in better public relations.

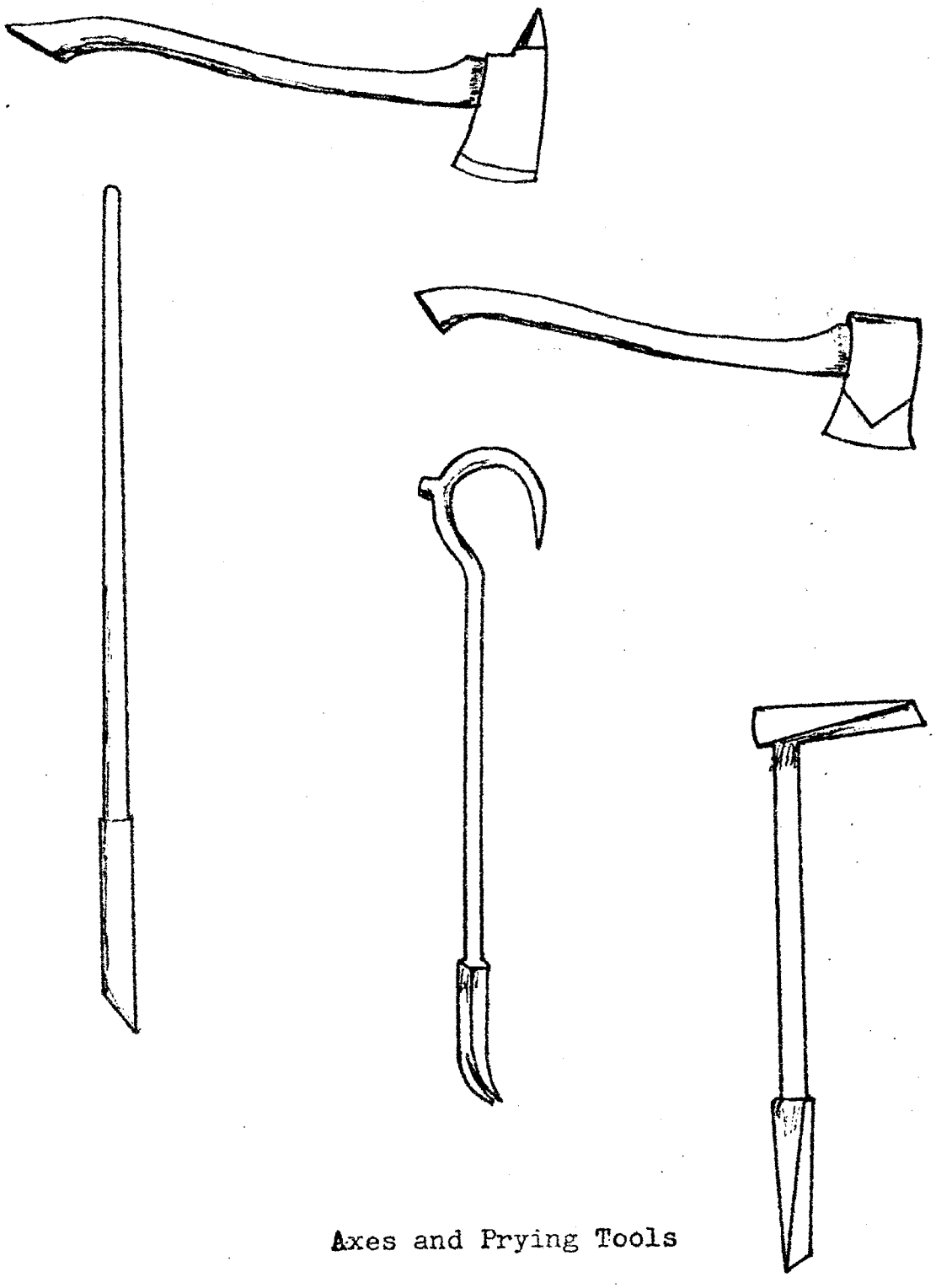
Forcible Entry Tools

It is important for firefighters to thoroughly understand the various tools and devices best suited for forcible entry procedure. Thus, the firefighter can best judge where and how to force entrance.

There are a variety of tools on the market which have been devised to make forcible entry possible. Such tools are often designed primarily for the fire service. The factor of safety, more than any other factor, should determine the method by which forcible entry tools are carried. When these tools are carried in the hands, precaution should be taken to protect the carrier, other firefighters, and bystanders. All tools should be used in a manner that will protect the firefighters and others from injury. When tools are not in use, they should be kept in their properly designed place on the apparatus.

Axes and Hatches

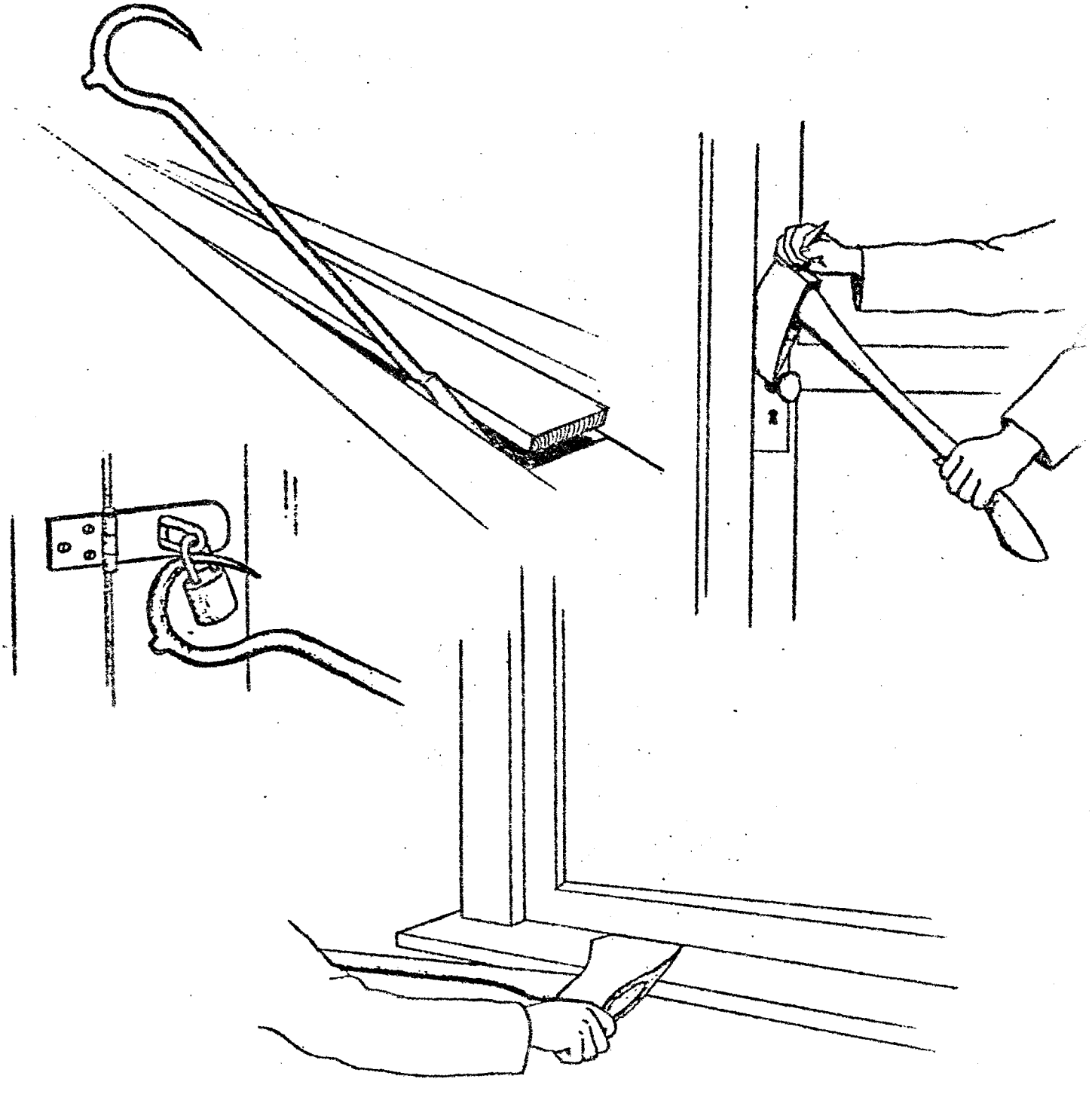
Firefighters use the flat-head axe and the pick-head axe for many purposes. The flat-headed axe is more adaptable to striking, but the pick-headed axe is more versatile for firefighting. Axes should be carried close to the body affording protection to the carrier as well as to bystanders. The point of the pick is shielded and the blade protected or pointed away from the body. The temper of the blade should be such that the blade will not bend easily or break off when nails, gravel, or other foreign objects are struck, yet not too thick to make driving through ordinary objects difficult.



Axes and Prying Tools

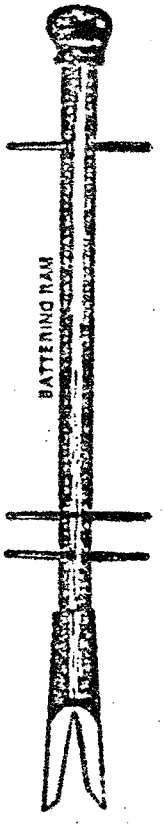
Prying Tools

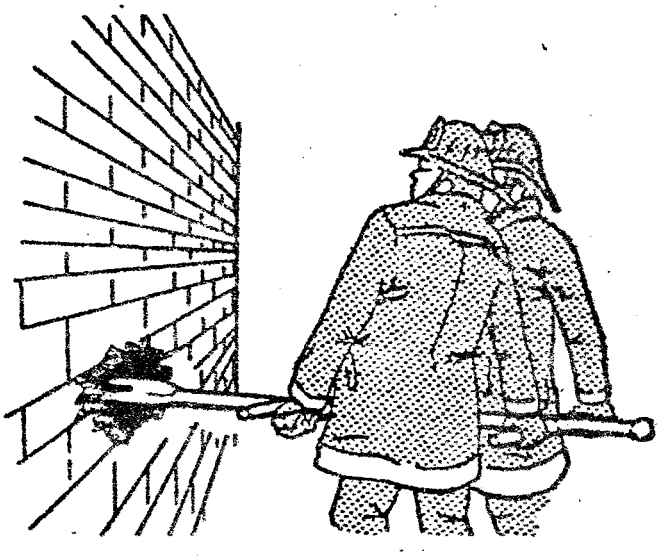
There are many different designs of prying tools used in firefighting. These tools are very effective in breaking locks, opening doors, forcing windows and prying up objects. The bit part of a prying tool should have a long narrow taper to permit entrance into narrow spaces, such as doors and windows.



Battering Ram

This tool is used to open heavy doors and to breach walls. It is designed to be used by two or four men. The head may either be a fork-type or ball-type.

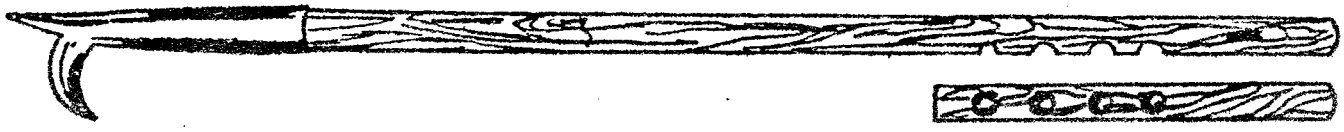




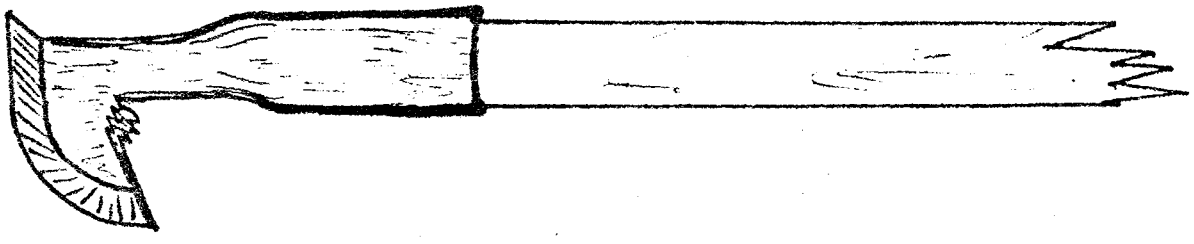
Hand and Power Saws

Wood and metal hand saws are useful where entry must be made through wood or light metal. Power saws can be equipped with carbide tip blades to cut metal or light concrete. Chain saws and saber saws are also useful. These power saws may be electrical, gasoline or compressed gas.

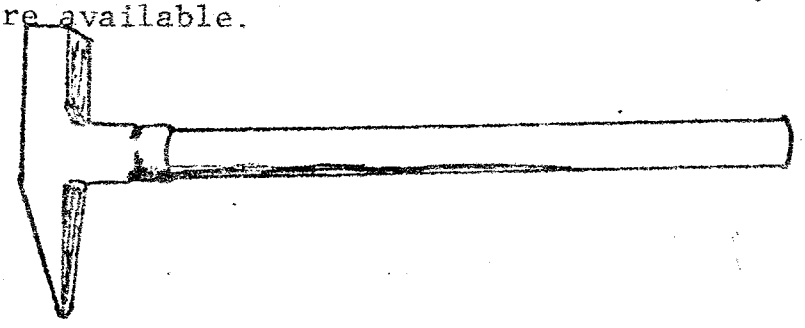
Pike Poles are useful as pushing and pulling tools. They are usually used to open windows, ceilings and partitions.

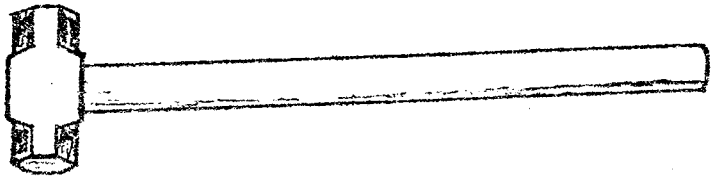


The EK Hook is a rugged forcible entry tool. It can rip floors, walls or roofs, penetrate plaster and metal.



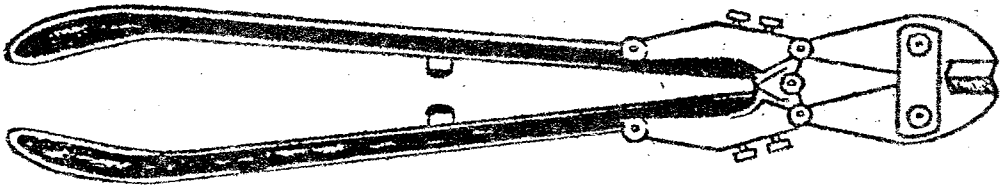
Hammer Head Pick and Sledge Hammer - The hammer head pick serves as a driving device and its longer, sharp-pointed pick may be used for digging dirt, concrete or debris. The hammer head can be used as a sledge hammer although it does not have as much striking power as a sledge. The sledge hammer may be effectively used to break out tile, walls, concrete, terrazzo or to free bars set in masonry. Several weights are available.

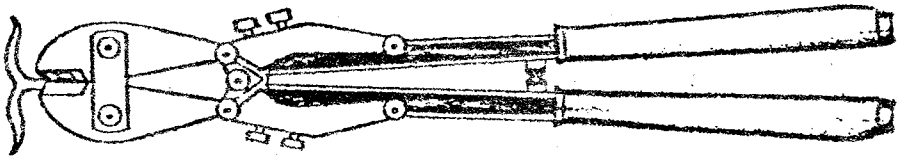




Metal Cutters - Bolt cutters are used to cut bolts, cables, padlock hasps and other objects. Wire cutters are used to cut wire fences. Wire cutters for electrical wiring must be an approved insulated type used with an approved insulated glove

Note: If possible, electrical wiring should only be cut by a trained technician.





Forcing Doors

Doors can be considered as obstacles to firefighters in their endeavor to reach various areas in the building. Various types of doors are used as entrance to buildings or areas within a building. The construction features of some doors render them extremely difficult to force and entry may be more easily made by some other means. From a firefighting view of forcible entry, doors may be classified as swinging, revolving, overhead and sliding.

Regardless of the type of door, firefighters should try the doorknob to make sure it is locked before force is used. The same rule of checking first would apply to windows as well. If the door is locked, examine it to determine which way it swings and which method of forcible entry will prove most effective.

The three general kinds of wood swinging doors are panel, slab and ledge. Residential doors usually open inwards while outside doors in public buildings should open outwards for emergency exit reasons.

Slab doors are widely used and may be constructed as either hollow core or solid core. Hollow core doors have cores that are made of wood strips forming a grid or mesh. These strips are glued within the frame forming a strong rigid core. Most exterior slab doors of newly constructed residences will be hollow core slab doors, but the exterior slab doors of older residences may be solid core. Solid core doors have a core of solid material, often built of tongue and groove blocks or boards which are glued within the frame.

Ledge Doors, sometimes called batten doors, are made of built-up material and are found on warehouses, storerooms, barns and other areas where a finished door is not necessary.

Metal Swing Doors may be classified as hollow metal, metal covered and tubular. Metal swinging doors are generally difficult to force because of the manner in which the door and door jamb are constructed. It is generally considered impractical to force metal doors. The framework of hollow metal doors is constructed entirely of metal. The jambs are fastened to the walls by specially designed metal anchors.

NOTE: When there is a heavy concentration of smoke/heated gases prior to forcing doors or windows, a charged line should always be available.

Cutting Torch - An acetylene cutting torch is classified as a burning tool and is very useful for entering an area blocked by heavy iron bars or iron plates. These cutting units are available as a back pack.

Hurst Power Rescue Tool - Nicknamed the "Jaws of Life", this tool features two hydraulically operated arms which can be opened or closed to spread, pull or lift up to 12,000 pounds. Although it is commonly used in extrication rescue work, its value in forcible entry should not be overlooked. The tool can be inserted into a door seam or between window bars and triggered to spread the opening. By anchoring one arm to a secure post or to the fire apparatus frame, the pulling capability is used to pull bars away or move a large item from a doorway. With special pinching-cutting head attachments, metal and wood strips can be severed.

Air Chisel - Numerous forcible entry cutting tasks can be handled efficiently with this tool. Powered by compressed air, the air chisel cuts by applying thousands of short-distance impacts per minute against a metal object. Specially designed kits include various chisel heads for different cutting needs. A long, flat chisel is often used for general cutting, and a short, flat chisel is used for tight spots. A medium length panel-cutting chisel can quickly penetrate sheet metal. Other attachments allow for pinching or hammering.

NOTE: A list of tools useful during forcible entry is not complete without the common hand tools found around the home. These include different types of hammers, screw-drivers, pliers and wrenches.

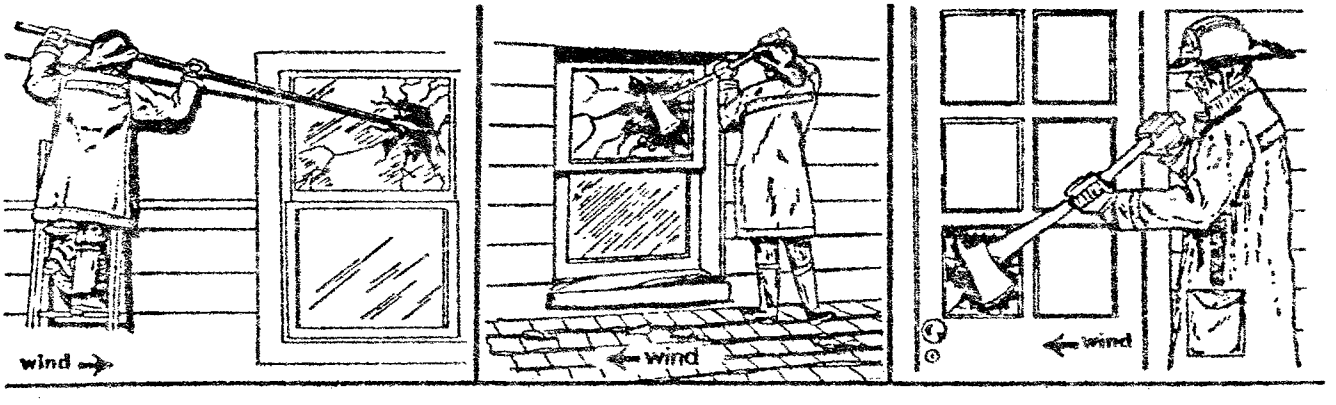
Tubular Aluminum doors are commonly used. The panels of these doors are generally glass, but metal panels are also used. The door's features include a butt hinge which is not easily forced and a lock thrown of more than one inch. When fire conditions permit time to carefully remove the expensive glass or bypass this type of door altogether, such decisions should be made.

Swinging Door Locks and Fasteners. Internal door locks for swinging doors consist of a bolt or latch that protrudes from the door into a metal striker plate which is screwed into the door jamb. During forcible entry, the jamb must be sprung far away from the door to allow the bolt enough room to pass the striker plate. It is usually extremely difficult to saw through the bolt or latch.

Breaking glass in doors can often be done very easily, certainly easier than prying at the jamb. In some cases, less damage may be done by breaking a small glass near the lock, through which the door can be opened from the inside. The principal safety procedures for breaking glass are:

- strike the tool at the top of the pane
- keep the body off to one side
- keep the hands above the point of impact

The broken particles of glass should then fall downwards away from the hands and to the side of the firefighter. After the glass is broken, remove all pieces to avoid cutting anyone and to prevent injury to hose, rope, etc., that may pass through the opening.



Techniques of Forcing Swinging Doors

The method to use in forcing swinging doors is first determined by how the door is hung, and secondly by how it is locked. Before attempting to force any door, a firefighter should check whether the door is locked, and whether the hinge pins can be removed. Before any door is opened or forced, the condition of the building should be observed and hose lines should be made available for use. The fire fighter should then feel the door for heat by using the back of the ungloved hand since the back of the hand is more sensitive to heat. The temperature of the door may indicate whether a back draft explosion is possible when the door is forced or opened.

The lock itself can often be removed or destroyed with less damage and later expense,which might occur, if the door is forced open. A few small handy tools are useful when the through-the-lock method is chosen. These tools are among the least expensive and some are also small enough to be carried in a coat pocket. Useful tools for going through the lock include the K-tool, key tools, vice grips, lock puller, drill and pliers.

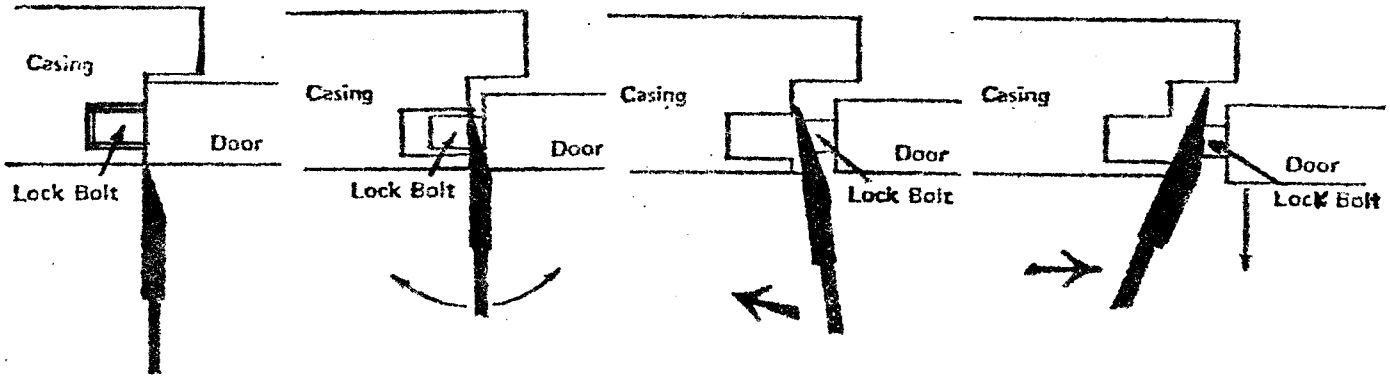
Forcing doors that open towards the firefighter:

1. Insert the blade of the prying tool between the door and jamb near the lock.

2. Force the blade in and against the rabbet or stop by working and pushing on the tool. Hammer the prying tool if necessary to push it as far as the stop.

3. Apply leverage on the pry bar away from the door to move the door and jamb apart.

4. Pull door open. If necessary, insert another tool in the opening and continue to pry until the lock has cleared the keeper.



Forcing doors that open away from the firefighter:

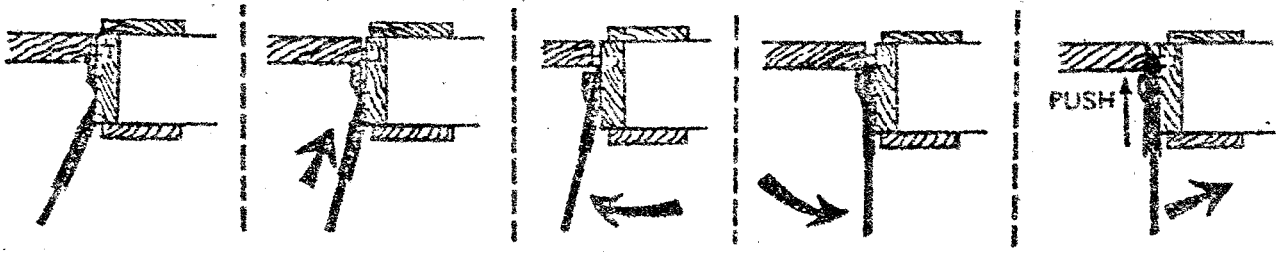
1. Bump the cutting edge of the tool against the stop to break the paint or varnish so the blade can be inserted.

2. Further loosen the stop at the lock location or remove the stop completely.

3. Force the blade between the door and jamb.

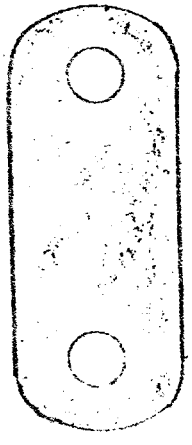
4. Make the initial pry after the blade is past the stop and press on the door edge near the lock.

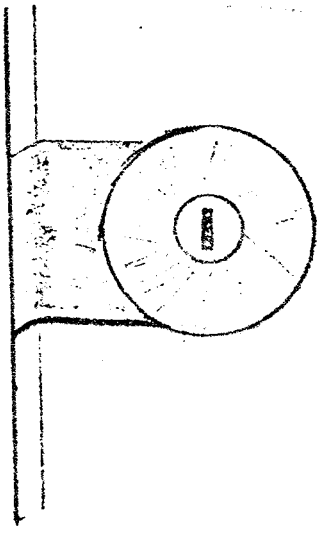
5. With a full bite behind the door, pry the door away from the jamb until the bolt passes the keeper.



A lock-stop device which can be made very inexpensively from discarded rubber inner tubes, permits firefighters the use of locked stairwell doors once they have been opened. These rubber lock-stop devices, are applied over doorknobs and prevent the engagement of the locking mechanism as illustrated below. Firefighters can easily carry these devices in their turnout coat pockets.

Note: Ladder companies should have a supply of these lock-stop devices.





Property Barriers

Hedges are more frequently found in residential areas. It is usually best to go around hedges. But it is not always possible to avoid them. If a fire requires entrance through a hedge - if a fire apparatus must enter the area - then several feet of the hedge may need to be removed.

Fences of wood, metal, masonry, and woven wire often pose an entrance problem. The gates on these fences are usually locked with padlock and hasps. These locks may be pulled apart by a claw tool, cut by some cutting tool, or pried apart with a pry tool. Another quick method, which applies to inecpensive locks, is to snap the bow of the lock with a hammer. The lock will then spring open or the bow will snap. Where chains and locks are used for gates, the best method of entry would be by cutting the chains.

A wooden fence may require that several boards be pried off or cut for safe entrance to the area. Wire fences should be cut near their posts to provide adequate space for fire apparatus.

Most barriers can be opened or knocked down, but as always, with only the minimum damage necessary.

Opening Locked Windows

There are many different types and designs of windows through which firefighters must force entrance in order to perform their rescue and fire extinguishment duties. Each type presents a different situation, and each situation requires a different technique if effective forcible entry is to be accomplished through them. It is often easier to force a window than to force a door, and entrance through a window may permit a door to be opened from the inside.

Breaking Window Glass

At fires in windowed structures with locked doors, breaking the glass in the door or window may be the fastest and least costly method of forcible entry. However, rash window breaking is both unnecessary and potentially dangerous. Released heat and smoke could injure a firefighter, and falling glass could likewise cause serious damage to personnel. Even if those hazards are immediately avoided, a delayed back draft situation could develop if coordinated ventilation and hose line readiness did not accompany forcible entry techniques.

When breaking glass:

1. Wear full protective gear.

2. Try the window to verify that it is locked.

3. Approach the glass from the windward side so that the wind will blow most of the smoke and heat away.

4. Keep hands above the point of impact to prevent broken glass from sliking down the tool handle.

5. Strike at the top of the pane close to the lock and clear out the glass by working downward.

6. Watch for signs of back draft, such as smoke being sucked back inside the window.

7. Have hose lines ready.

8. Clear all remaining jagged pieces of glass from the frame to prevent injury to personnel or hose lines.

9. Reach in and release the locking mechanism.

Opening Walls

The firefighter may occasionally be confronted with a forcible entry problem involving a building which may be windowless and have heavy duty maximum-security doors and locks. Another type of problem would involve a common type of building which requires an entry where no convenient window or door is located. Then the firefighter must deal with the harder, more time consuming tasks of opening walls or partitions or ceilings.

The exterior walls of a building may be one of the following types of construction: masonry, metal or wood frame.

Masonry exterior walls may be constructed of brick, stone, concrete blocks, or glass blocks. These are very desirable and in common use because of their fire resistive qualities. Such walls are usually 8 to 12 inches thick depending on the material used. The opening of masonry walls is often referred to as "breaching." A breaching device known as a battering ram is made of iron with handles and had guards. A useful design has one end jagged so that it will break brick and stone, and the other end rounded and smooth for battering walls and doors. For light work, two men can operate the battering ram, but for heavier work requires four men.

Various power tools, such as impact hammers or drills, are faster than the battering ram for breaching masonry and concrete walls. Not only are these tools faster, but they usually require only one man to operate them. Heavy duty circular saws with masonry cutting blades can cut through concrete blocks. Charged lines should be in position before breaching a wall at a fire.

Metal and prefabricated metal walls are becoming more and more popular for exterior wall construction of storage buildings, service stations, store fronts, and other commercial structures. The metal for these walls is usually in the form of sheets, sections or panels. These metal sheets are fastened to wood or metal studs by bolts, screws, or welding. A damaged panel may be difficult to replace. Entrance through a door or window is usually preferred to opening a metal wall and its breaching is considered a "last resort." If opening a metal wall cannot be avoided, a metal-cutting power saw is normally the best way to open the wall.

Wooden frame walls are constructed with wood or fiberboard sheathing nailed over the studs. Over the sheathing is fastened the exterior siding. The framework between the studs is hollow or may be filled with insulation material. It is not always necessary to completely open a wooden frame wall. But it is extremely important to watch for electrical wiring and pipes.

Opening Ceilings

Ceilings consist of built-up materials applied to the underneath side of the floor joist, concrete floor, or ceiling post. This built-up material may be broken into from below with the use of either a pike pole or a plaster hook. When opening a ceiling, a firefighter should not stand under the space to be opened. The firefighter should pull the ceiling down and away to prevent the ceiling material from dropping on his head. No firefighter should attempt to pull down a ceiling without wearing a helmet, and he should stand between his work and an opening through which he can retreat if necessary.

The head of the pike pole may turn after it has been forced through a plaster or other type wall. It may become difficult to determine the direction in which the pike on the head of the pole is pointing after it has been driven through a ceiling. This difficulty can be eliminated by making small notches on the pike side of the handle. A firefighter can then keep the head lined up with the original hole.

Opening Roofs

It is usually a rare occasion when a roof opening is the only method of entering a fire area or the quickest method because of security-type doors and walls. Several layers of materials must be cut when opening a roof. The materials used in roof construction in some way determine its ability to be cut. Perhaps the best way for a fire department to determine the material from which roofs are constructed is through inspection surveys, at which time such information can be collected and made available to firefighters.

When cutting through a roof, the firefighter should make a rectangular or square shaped opening to facilitate later repairs. One large opening, at least 4 feet by 4 feet, is much better than several small ones.

Procedures for opening a wood joist or rafter roof with an axe:

1. The following factors determine the location for the opening to be made.

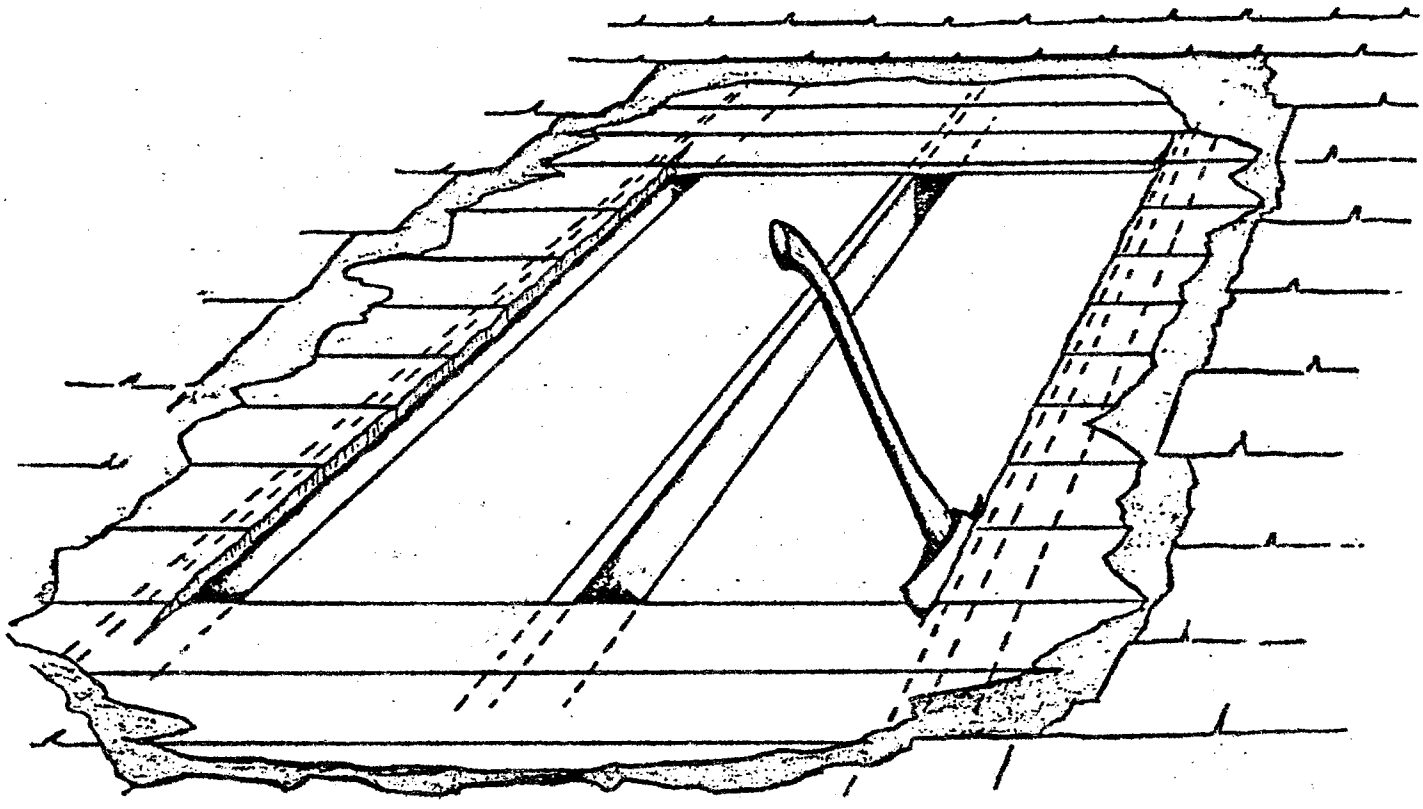
   a. Location of intense fires
   b. Highest point on roof
   c. Direction of wind
   d. Existing exposures
   e. Extent of fire
   f. Obstructions

2. Locate roof supports or rafters by bouncing the axe on the roof. Between the rafters or joists, it will sound hollow while near or on top of a support, it will sound dull and solid.

3. Remove the shingles or other built-up roof material sufficiently to permit the initial cut to be made. Use the pick head to pull the material out of the way.

4. Cut the wood decking diagonally alongside the joist toward the hole. The joist should never be cut.

5. Use short strokes when chopping. After all cuts have been made, pry up the roof boards with the pick end of the axe. After an opening has been completely cut in the roof, push the blunt end of a pike pole, EK hook, or some other suitable tool through the roof to open the ceiling below.



Power tools are preferred over using an axe for opening a roof. Although the circular saw requires more skill and care than an axe, the resulting hole is not only quickly completed, but it is also neater. This consideration takes on more importance when repairs must be made by the owner. The general steps with a circular saw are similar to those using an axe.

Precast or reinforced concrete roofs are extremely difficult to break through. This method of entry should be avoided whenever possible.

Metal roof coverings are made from several different kinds of metal and are constructed in many styles. Corrugated galvanized sheet metal and aluminum can usually be pried from their supports. Metal cutting tools or power saws with metal cutting blades must be employed to open metal roofs. Metal roofs on industrial buildings are usually provided with adequate roof openings, skylights or hatches.

Opening Floors

Forcible entry practices not only involve the initial entrance at a fire building but also include other forcing needs to get closer to the fire after the firefighters are inside. An example would be the opening of floors. There are almost as many kinds of floors as there are buildings. The type of floor construction is however, limited to two basics: wood and concrete. Either of the two may be furnished with a variety of floor covering materials.

The feasibility of opening a floor during a firefighting operation depends on how and of what material it is constructed. A wood floor does not in itself guarantee an easy job, for the wood might only surfacing a concrete floor. Wood floors may be opened with a fire axe in almost the same way as a flat roof. There are however, two separate cutting jobs because the finished floor (which may be linoleum, tile, hardwood flooring or carpeting) and the subfloor usually run in different directions.

The following are steps for opening wood floors with an axe:

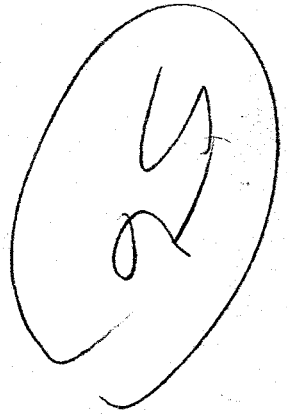
1. Determine the location of the hole, sound for floor joists and cut one side of the finished floor by using angle cuts.

2. Cut the other side of the finished floor as directed above and remove the floor covering with the pick end of the axe.

3. Cut the subfloor using the same technique and angle cuts. It is usually advisable to cut all sides of the subfloor before removing the boards. If just a few boards are removed before the others are out, the heat and smoke may prohibit completion of the job.

A gasoline-powered circular saw can quickly and neatly cut a wood floor in a similar manner as for opening a roof. Floors which are covered with tile, linoleum or other such materials should first have those materials removed before the floor is cut. Carpets and rugs should also be removed or rolled to one side before a floor is cut.

The general construction of reinforced concrete floors makes them extremely difficult to force and opening them should be bypassed if possible. If concrete floors must be opened, the most feasible means is to use a compressed air jackhammer. Unless a jackhammer is readily available, the process is extremely slow and may not prove beneficial for fire extinguishment. Concrete cutting blades, which are available for most portable power saws may prove to be helpful.



VENTILATION

Introduction

Ventilation, as applied in firefighting, is the planned and systematic removal of heat, smoke and noxious gases from a structure and the replacement of these elements with cooler air.

Occurences such as back drafts have taught firefighters to realize that the subject of ventilation is second in importance only to that of the application of extinguishing agents. In many cases, proper ventilation is crucial in determining and permitting the proper application of an extinguishing agent.

It is essential that the subject of ventilation not be approached casually. Since no two fires are alike, one cannot rely upon knowledge gained in the field alone. The effective firefighter must incorporate his practical experience with the theory and standard practices of ventilation.

The purpose of this section is to concentrate on the principles and practices of ventilation from a basic point of view.

Purpose of Ventilation

The replacement of heated air, smoke and gases with cooler air:

1. Aid in saving lives and rescue
    a. Provides breathable air for victims and rescuers.
    b. Improves visibility: rescuers can find victims and victims may find their own way out.
    c. Removes discomfort of excessive heat.
2. Speeds firefighting
    a. Provides for rapid location of fire and speedier extinguishment.
    b. Enables firefighters to determine path of fire and to take proper steps for its control.

3. Prevents or lessens the danger of back draft explosions.

There are three flammable or combustible elements which serve as fuel in back drafts: carbon MONOXIDE ~~dioxide~~, finely divided carbon particles and tar balloons which are hollow droplets of condensation of unburned gases suspended in the air. These three substances may be produced when a fuel in a closed, oxygen-poor structure is practically burned or highly heated.

During a fire, flammable gases are vaporized from the combustible materials involved. When these fuel gases are heated to their ignition temperatures, they will burn if sufficient oxygen is present. If there is insufficient oxygen, the unburned gases may collect in pockets throughout the structure or fill the entire building.

It is highly probable that when a fire has been smoldering in a closed structure for some time, the conditions for a back draft have been established. Two sides of the fire triangle, fuel and heat, are probably present. The third side, oxygen, need only be admitted at the proper moment to cause a very rapid burning of the gases, the expansion of which may be sufficient to cause an explosion.

When a building is charged with heat and smoke, and it is impossible or impractical to open up the top, the following procedures are recommended: First, a charged hose should be in position. Next, the door should be opened while all personnel stand well to one side outside the structure. The swing of the door will determine which side of the doorway to stand. If the door opens outward, stand on the opposite side of the hinges when you open the door. Wait an appropriate time determined by the size of the structure, degree and intensity of the conditions inside, etc., for a back draft to occur.

4. Controls spread of fire, reduces mushrooming.

Heat rises until it meets an obstruction such as a ceiling. It then spreads horizontally at the top of the structure, seeking an outlet. An outlet in the roof, preferably directly over the fire, will allow the rising heated gases and smoke to escape. This will tend to localize the fire by creating a chimney effect whereby air currents travel from

almost all areas of the fire floor toward the vent-hole carrying the heat and flame with them.

5. Reduces property damage caused by fire, water, heat, and smoke (Permits prompt salvage operations)

Rapid extinguishment of the fire through ventilation reduces not only the actual fire damage but also water damage and smoke damage. One method of ventilation is the application of water into the heated room in the form of water fog or spray. The gases and smoke could be dissipated, absorbed or expelled by the rapid expansion of the water when it is converted to steam. This method reduces the amount of water required to extinguish the fire.

Smoke may be removed by controlling heat currents, by collecting carbon in the condensed steam, by dissipating smoke through the expansion of water as it is turned into steam, or by mechanical process. Regardless of the methods used, ventilation reduces damage as fuel vapors and carbon particles are removed.

The efficient confinement of a fire through proper ventilation enable salvage operations to be initiated even while fire control is being accomplished.

Ventilation Process

Timing

Although ventilation may be performed at any stage of the firefighting operation, it is normally done very early, if not as the first step. Often, ventilation is a continuous process in a structure containing many rooms and floors.

Since ventilation accelerates the fire by admitting fresh air, ventilation should not start until there are manned, charged hoselines ready to cover the men doing ventilation work.

However, there is one exception to the standard practice. In multi-storied buildings where there is the danger of mushrooming, firefighters should open up skylights, scuttle covers and doors at the top of stairways.

Deciding Factors

At the site of the fire, an officer must evaluate the situation and judge whether ventilation is necessary. Many factors will have a bearing upon the location to ventilate. Among them are:

- availability of natural openings such as skylights, hatches, elevator shafts, windows, doors, etc.
- location and condition of fire.
- direction where chief officer wishes fire to be drawn.
- materials burning.
- type of building construction.
- wind direction and other weather conditions.
- extent fire has progressed.
- condition of building and its contents.
- extinguishment methods.

Only after considering the above could he determine if ventilation is required. The person accomplishing ventilation should also be constantly aware of the effect ventilation will have on the fire. He should also give consideration to the department's available manpower and equipment prior to actually opening the building.

Ventilation Location

Once the decision to ventilate is made, the next step is to locate the point at which the building should be opened. Although ventilation is not a method of fire extinguishment, it is a means by which firefighters can control the fire more efficiently and prevent property damage.

A smoke-filled building does not automatically mean that gases are heated to the point that there is danger of an explosion, as the fire may be in the second or "freeburning" and contents may also have absorbed much heat. Under these conditions, it may be possible, with the use of breathing apparatus, to enter the building and extinguish the fire without ventilation.

The ideal situation in selecting a place to ventilate is one in which firefighters have prior knowledge of the building and its contents. Knowledge of the type of building involved is a great asset when making decisions concerning ventilation. Special construction features such as staircases, elevator shafts, and roof openings are determining factors.

Checking building permits will often reveal information concerning ventilation and air-conditioning systems, the type of roof construction, roof openings and paths of escape for smoke, heat and gases.

Usual Areas to Ventilate

Roof - use natural openings, if reasonable:

- skylights and roof ventilators
- scuttle covers
- penthouse doors
- attic louvers
- if no such openings are available, a hole must be cut in the roof.

Windows - should be opened on the fire floor and on all floors above the fire floor if heat or smoke has accumulated there.

Doorways - open these as necessary to permit air circulation to drive smoke and gases through desired channels.

Usual Procedures

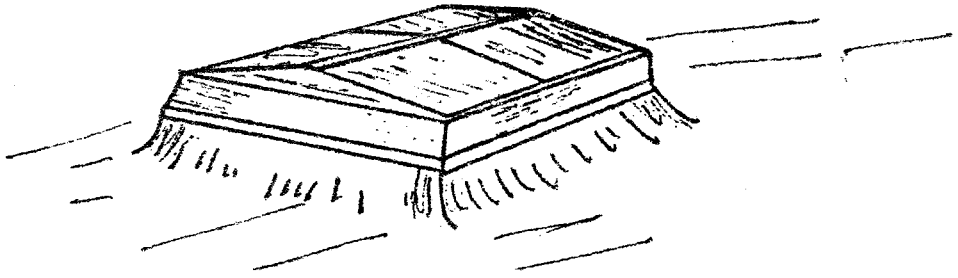
If an entire building requires ventilation, firefighters should begin at the top of the structure and proceed down one floor at a time ventilating as they go. If the lower floors are ventilated first, fire may extend through the openings making the upper floors untenable. It may then be impossible to perform firefighting duties above the first floor.

In all ventilating operations, unnecessary damage should be avoided. Natural openings should be used possible. The firefighter should be certain that he makes only those openings which are absolutely necessary. For example, if a window can be opened, it should not be broken. An attempt should be made to cut the initial opening large enough to do the job since the repair cost on several smaller holes is greater than for one large hole.

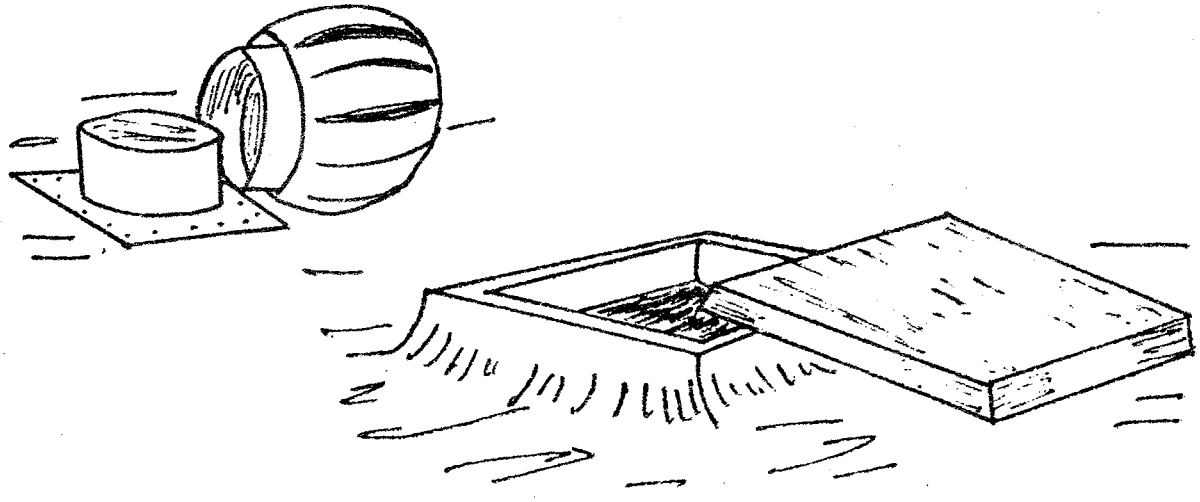
How to Ventilate

Roofs: there is no absolute rule for selecting the exact point to open a roof except, "as directly over the fire as possible".

1. Skylights may be removed by prying loose with an axe. Glass may then be lifted or slid out. If removal isn't feasible, break the glass.



2. Scuttle covers and ventilators may be pried off with an axe.



3. Penthouse doors may be opened. If locked, use an appropriate forcible entry tool such as a lock breaker, ram bar, axe, etc.

4. Cut a hole in the roof. This may be done after determining that the above steps are unfeasible or insufficient. The most commonly used tools are the pick axe, the gasoline powered circular saw and the chain saw.

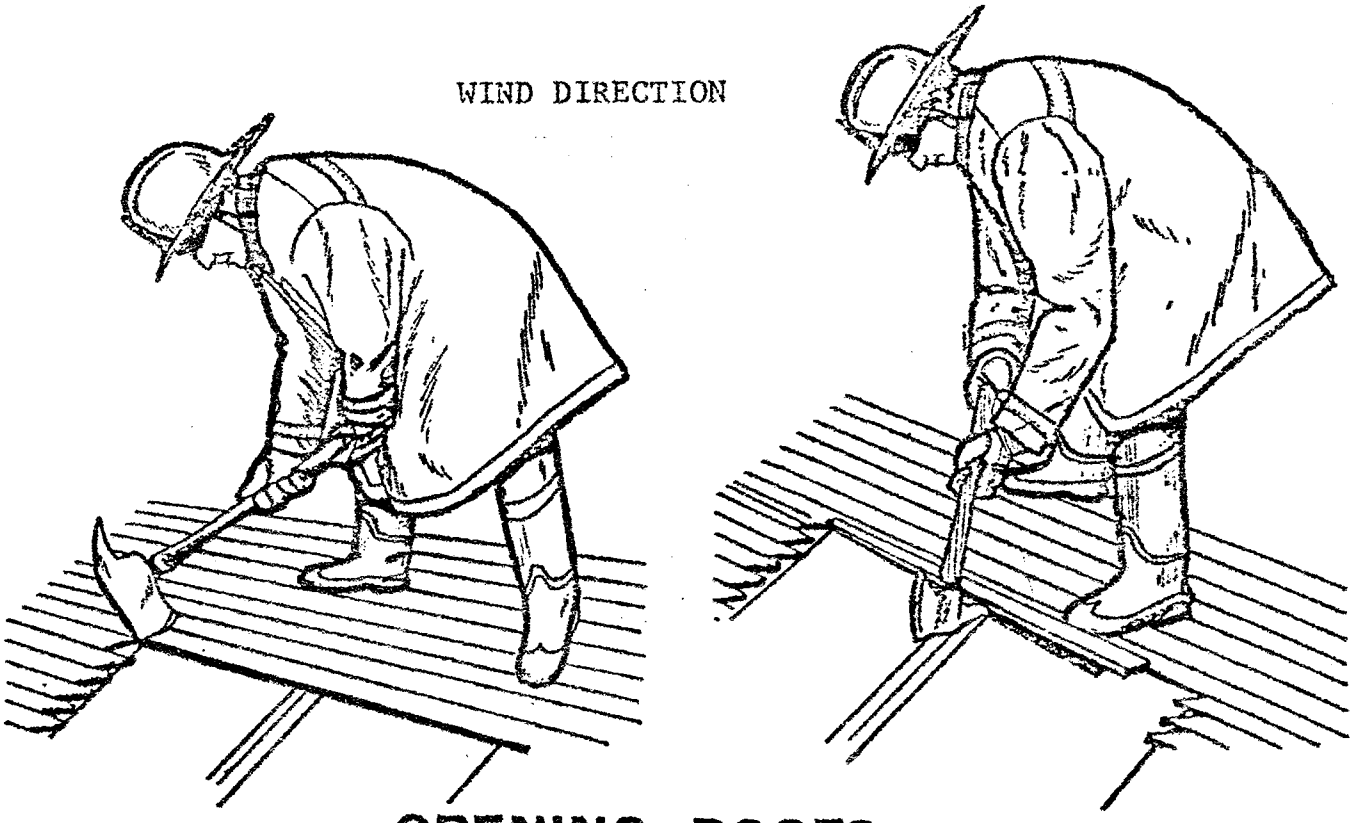
   The size of the hole to be cut depends upon the extent of the fire and the volume of the structure. Less time and work are required for one large hole than several small ones. (One 8' x 8' hole is equal in area to four holes each of which is 4' x 4' square.) Also, one large hole is more economical to repair.

   There will be occasions where more than one hole may be required, especially in buildings with vast areas and/or many walls.

   Hole location - where the hole is to be cut should be carefully selected. This is sometimes easily done by noting the area of blistering, discoloration or smoke seepage. In other cases, feeling for hot spots with the hand will indicate where to cut.

   The objective is to cut the hole as directly as possible above the fire. On roofs of multi-storied structures, the opening should be made over a stair-well, elevator shaft, ventilation shaft or hallway.

   On peaked roofs, the hole should be cut at the highest possible point and on the leeward side of the peak.

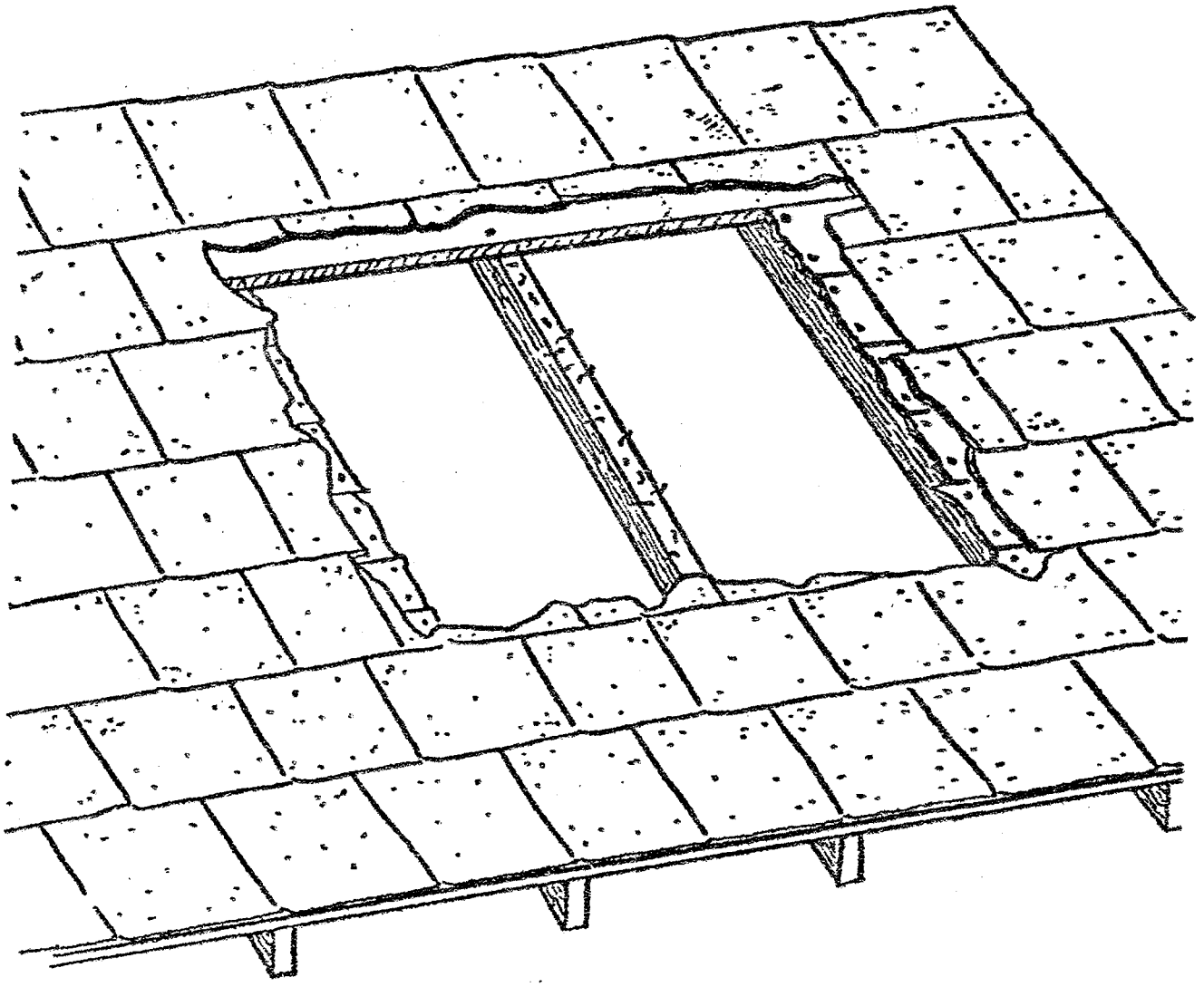


OPENING ROOFS

Cutting the Hole:

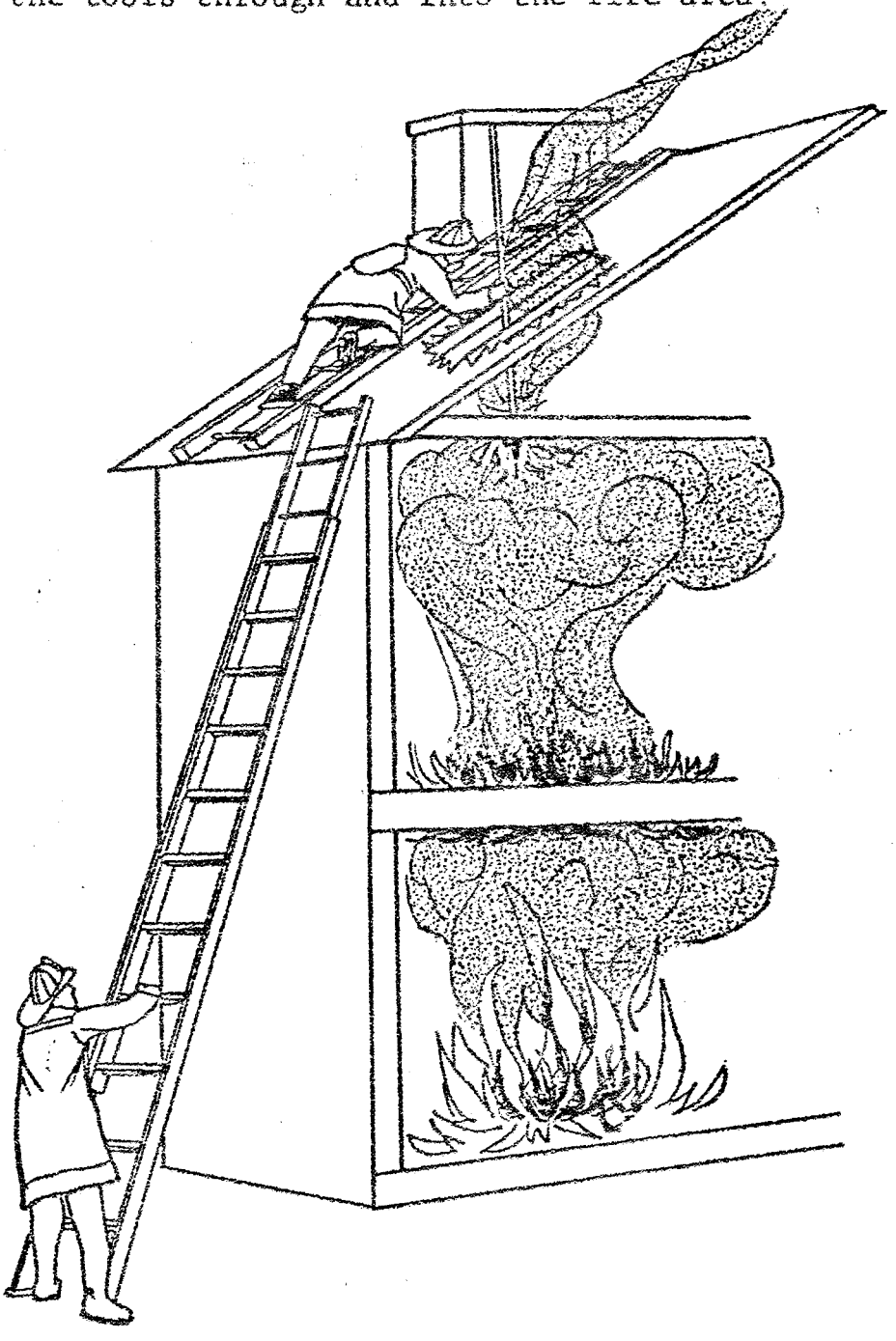
The preliminary step is to ascertain the rafter locations. The roof covering, such as shingles, tar paper, tin, etc., may have to be removed to do this because the object is to expose the line of nail heads which are holding the sheathing to the rafters. If the nail heads are not visible, a few "sounding" blows with an axe will usually locate the rafters quickly.

Parallel cuts, usually no less than four feet apart, should then be made through the sheathing alongside the rafters. The sheathing between the cuts may then be removed, working from leeward to windward. The firefighter should keep his back to the prevailing wind.



PROPER ROOF VENTILATION

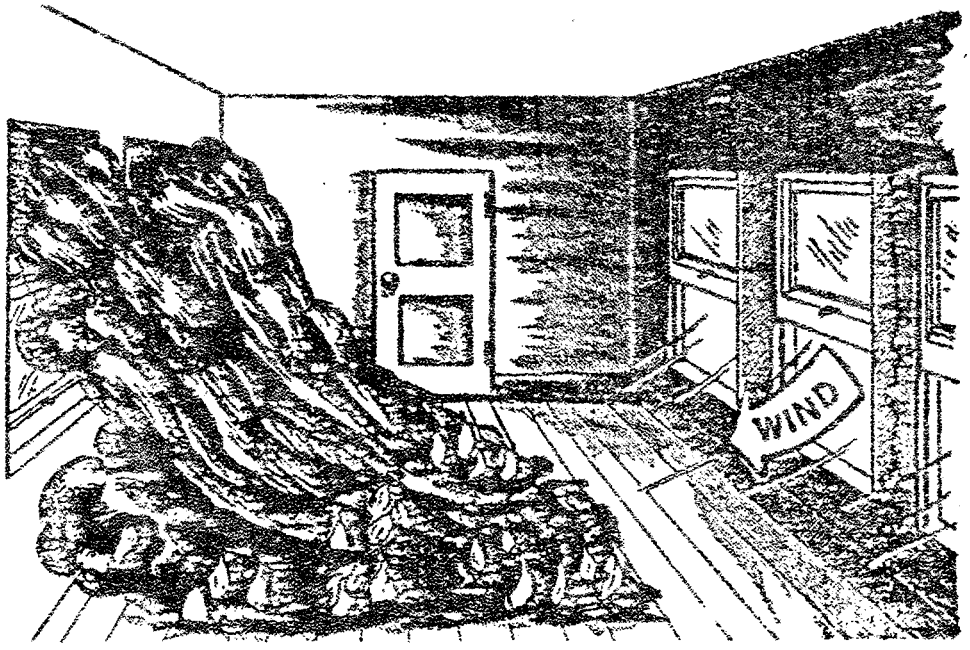
Merely cutting a hole in the roof does not complete the job, for if the ceiling is still intact, it must be broken through. This is done from the roof, working through the hole which has just been cut. Axes, pike poles or straight ladders may be used for this operation, being careful not to drop the tools through and into the fire area.



While it is a good practice to have one or more charged hose lines on the roof for personnel and exposure protection, water streams should not normally be directed down through the vent hole. This action would nullify the venting effect by driving heat, smoke and steam back into the building.

Windows - If conditions permit, windows should be opened from inside the building so that blinds, shades, curtains, drapes and screens can be removed or pushed to the sides of the opening to allow the free passage of air. Note that a window screen can block off as much as 50% of the air which would normally pass through the opening.

Some authorities think double-hung windows should be opened two-thirds of the way from the top and one-third of the way from the bottom. Others maintain the important thing is to get them open at the top to let the smoke out since fresh air will always find a way in to replace it. A third method is good for cross-ventilation in that the windows on the leeward side are opened from the top while those on the windward side are opened from the bottom. Regardless of which method is used, the windows on the leeward side should be opened first.

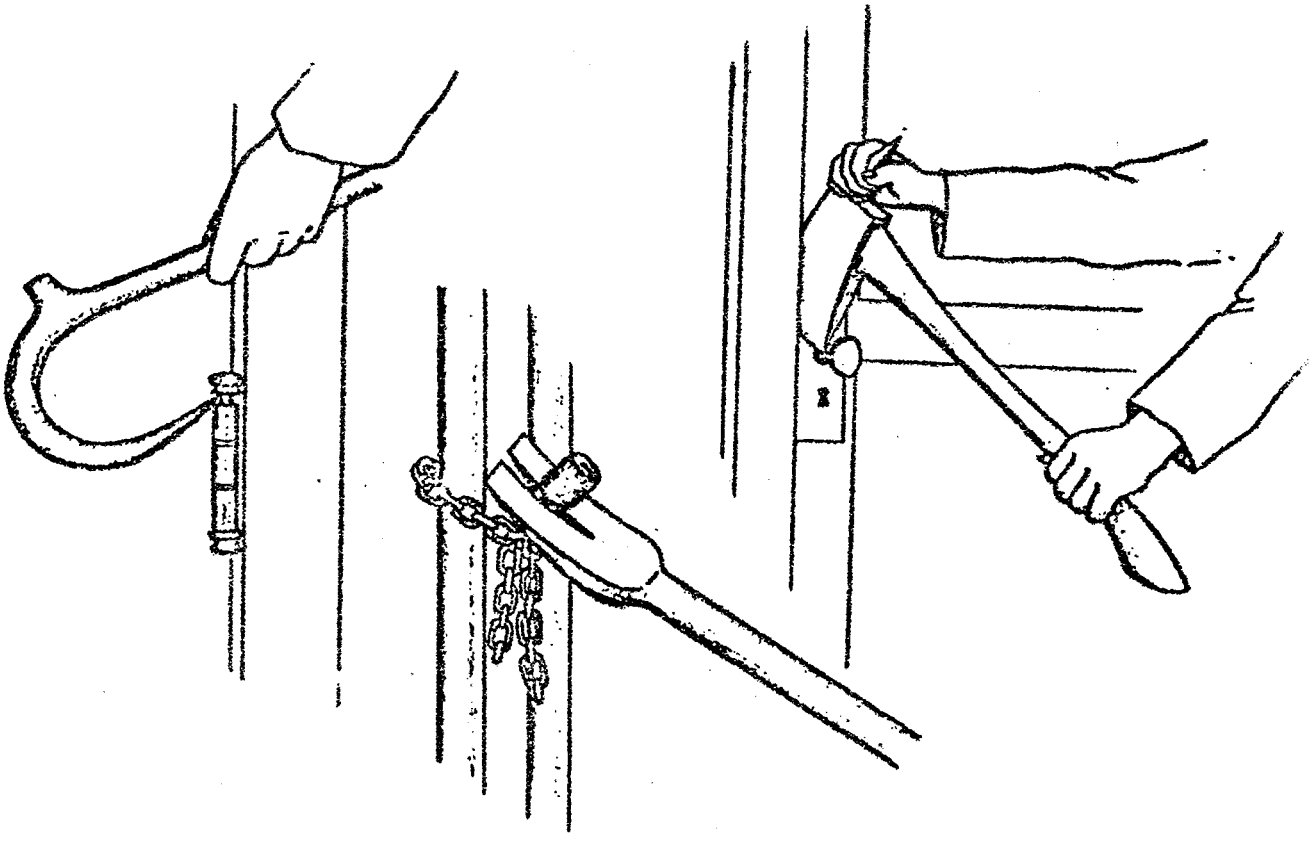


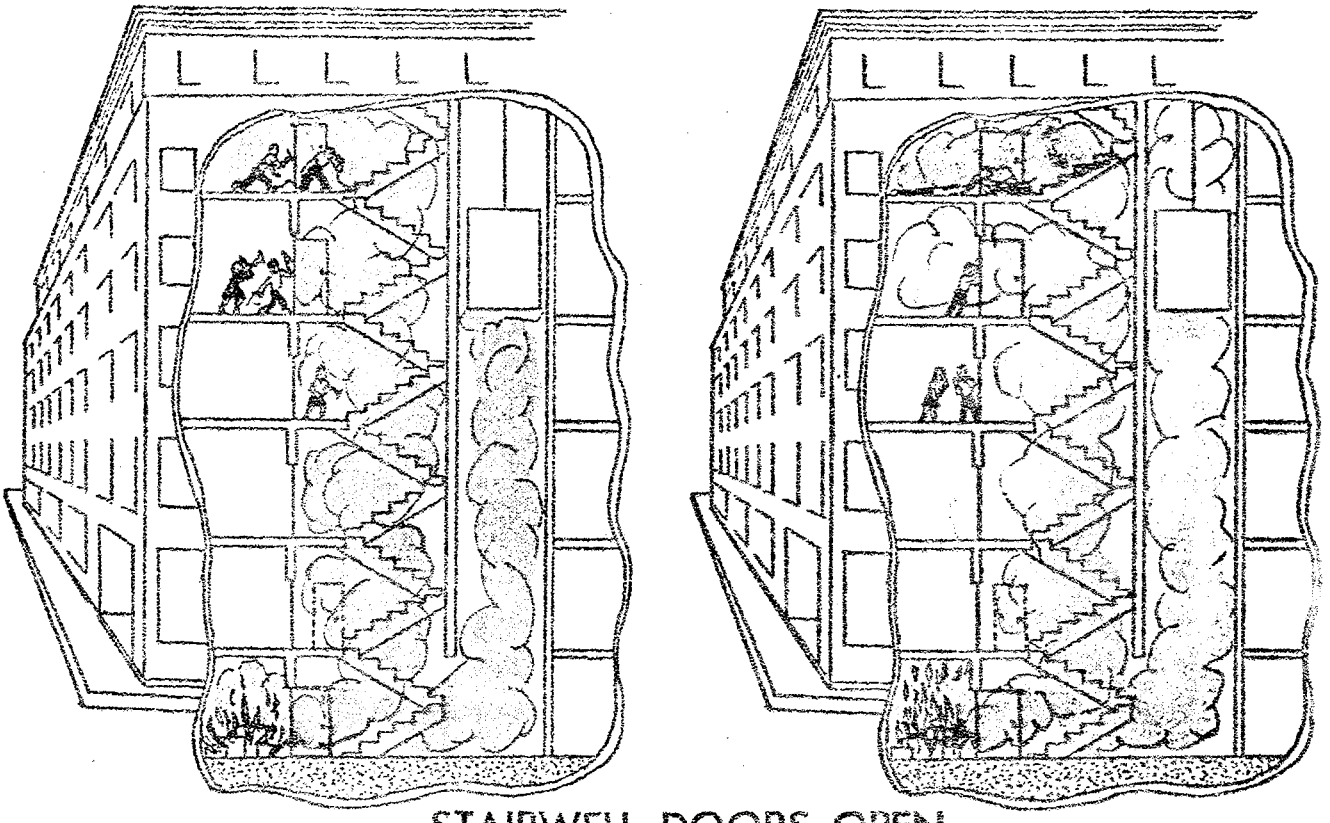
To break a pane of glass, stand to one side and strike the upper portion of the pane with the flat side of an axe swining in a slightly downward motion. This action allows the axe head to carry the glass into the building. The top of the pane should be broken first before striking the lower portions of the pane in order to lessen the possibility of damage by falling glass. Starting from the top and working down, clear the framework of all glass to avoid injury by any remaining jagged pieces.

Ordinary windows which are jammed or painted shut are almost impossible to open. These should be broken out immediately. This type of glass is usually cheap. A hose stream or the flat part of an axe will do the job very well on ground level windows. Upper story windows can be quickly and easily broken by allowing the tip of a ground ladder to fall against them. Personnel should warn men working below when windows are to be broken on upper floors.

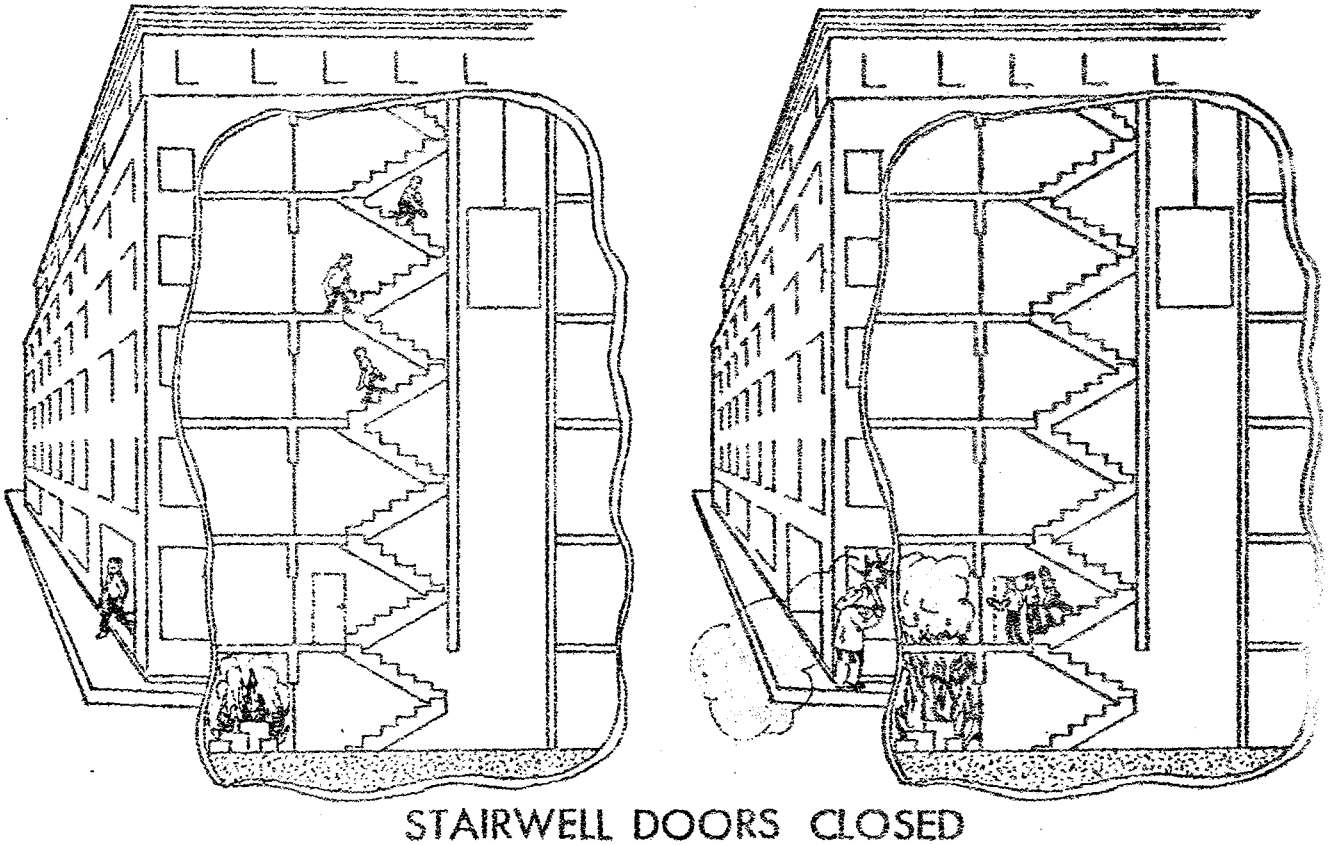
Large plate glass windows, such as those in department stores, are expensive as well as hazardous to break. These should be left intact unless it is absolutely necessary to break them. These windows will usually have lighter glass transoms above them which are easier, cheaper and safer to break.

Doors - opening doors for ventilation is a simple matter. There are, however, a few important points to keep in mind before performing this operation.





STAIRWELL DOORS OPEN



STAIRWELL DOORS CLOSED

Fire doors should never be opened unless the fire is definitely out or so well controlled that there is no chance of its extending into the area protected by the fire door.

Tempered glass doors are usually exterior doors. These possess greater strength than ordinary plate glass, extremely difficult to break or force and are relatively expensive to replace. All alternative means of providing ventilation should be considered before attempting to open or break these doors.

If tempered glass must be broken, a sharp rap with a pointed tool such as a pick axe can do the job. The glass will not splinter into long, daggerlike shards, but will practically disintegrate into very small pieces. Personnel should stand well to one side to avoid what may be a virtual shower of small glass fragments.

Mechanical Ventilation

While natural ventilation is sufficient to clear contaminated atmospheres from most buildings, mechanical ventilation is often necessary in such structures as cellars, basements, tunnels, vaults or buildings with vast areas or many partitioned walls.

Methods: two types of mechanical ventilation are popular -

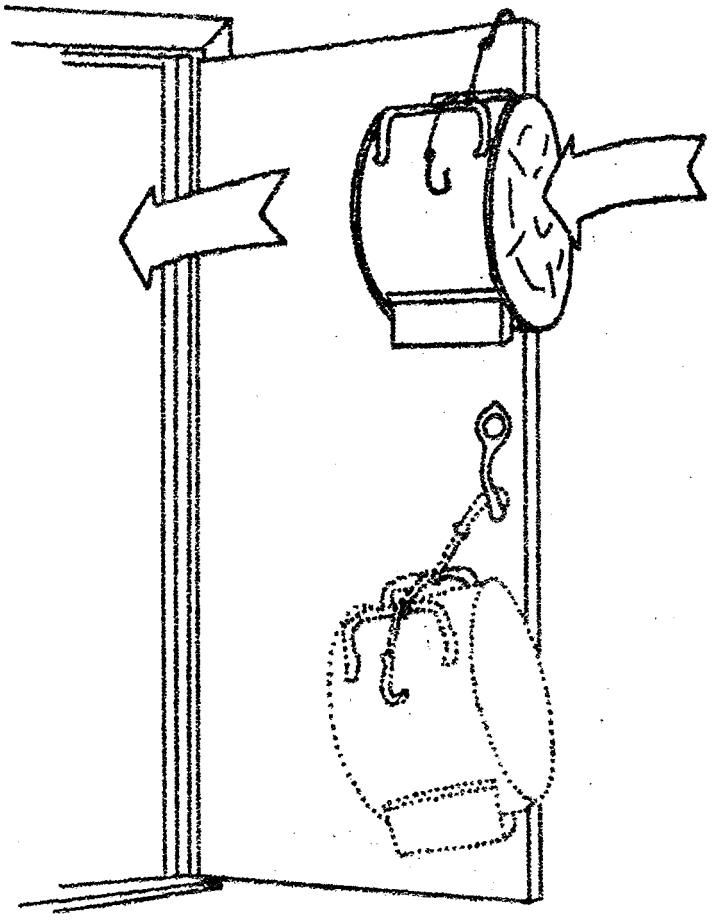
a. Fan-type smoke ejectors which may be either gasoline or electrically driven.

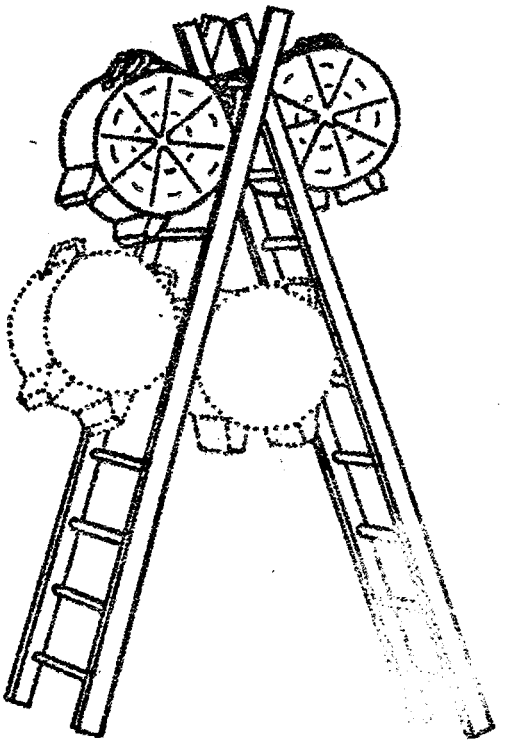
b. Fog streams

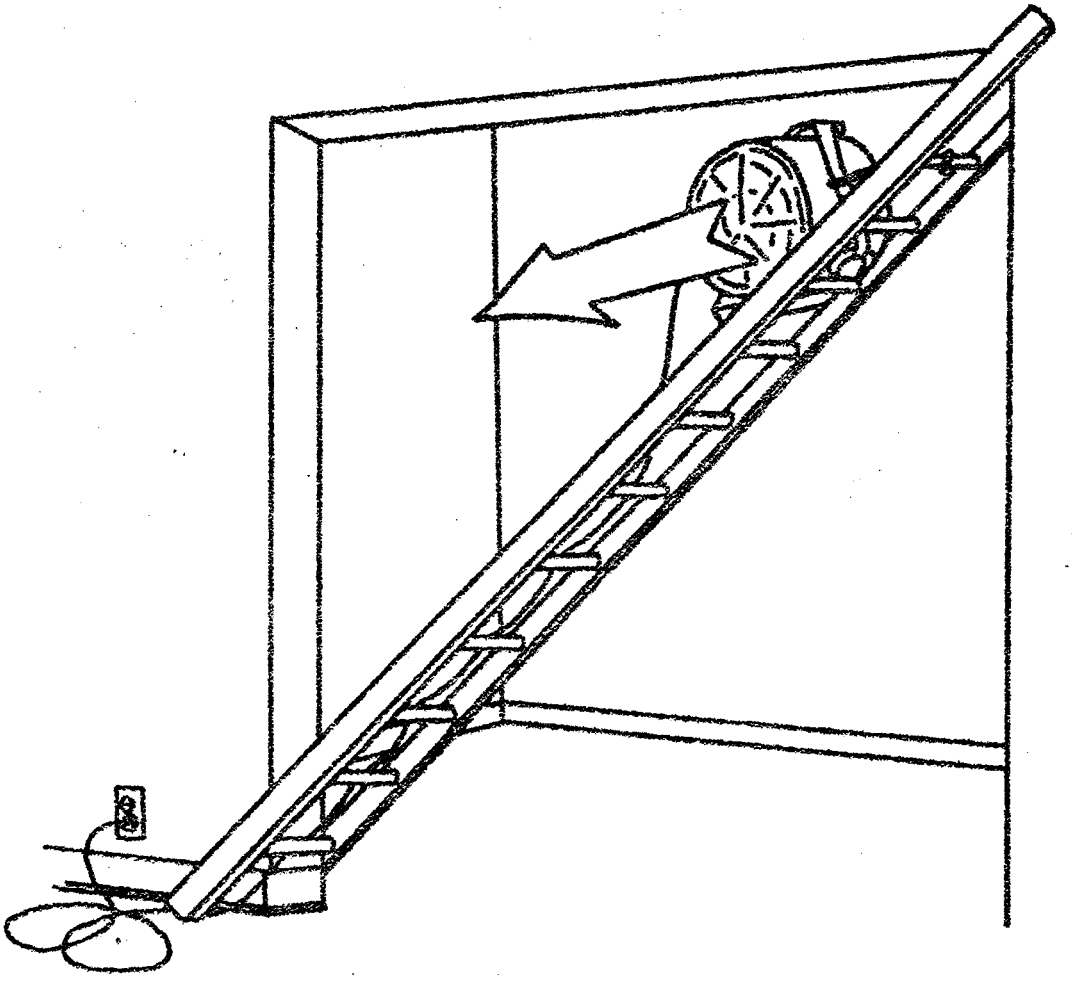
Fan-Type smoke ejectors:

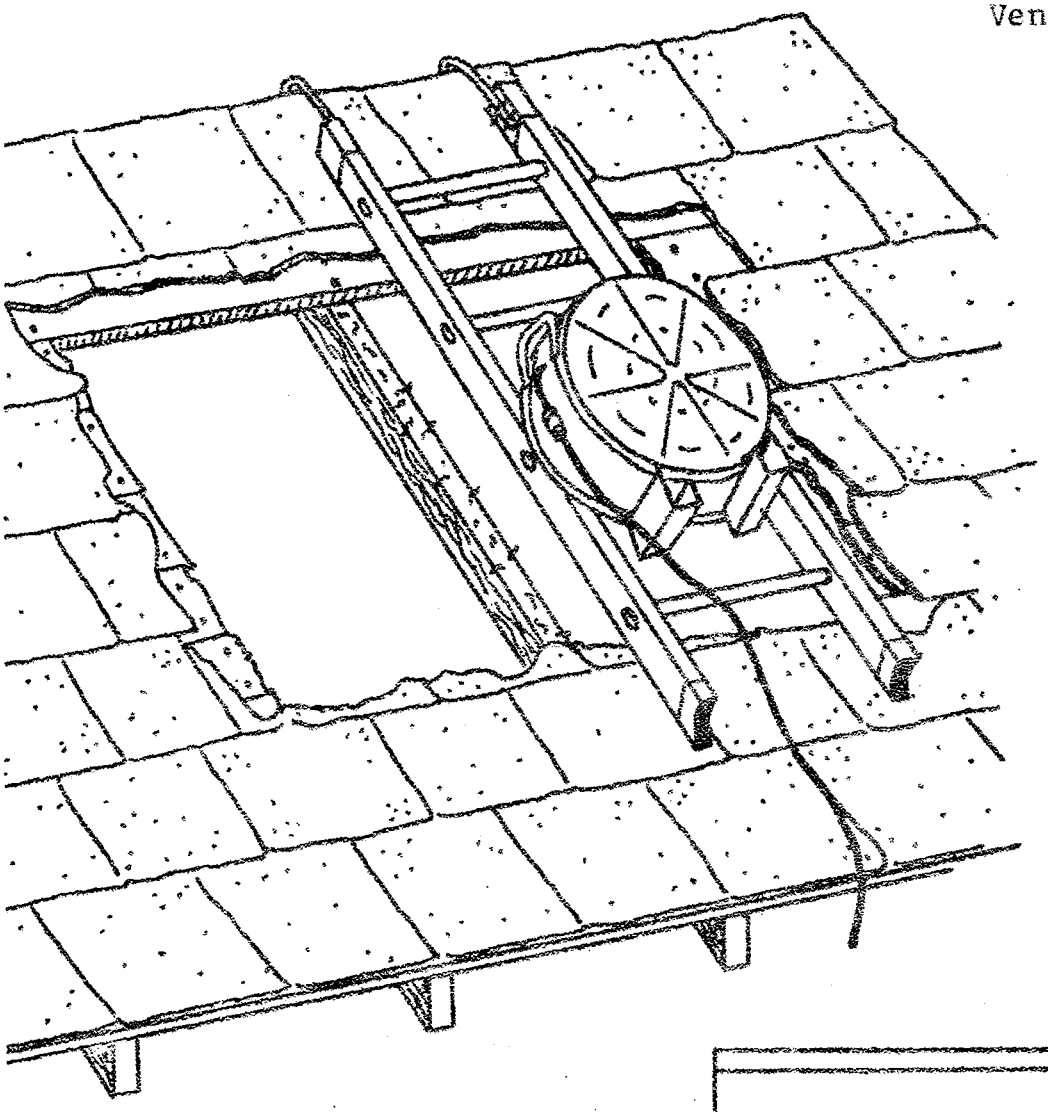
Depending upon the size, fan-type smoke ejectors have capacities ranging from 5000 to 15000 cubic feet of air per minute. They are simple to use. They may be situated to blow smoke out of a building or fresh air into the building. Normally, the most efficient method is to set up two or more ejectors to blow smoke out the lee side and fresh air in from the windward side simultaneously. Before beginning mechanical ventilation, the direction of the prevailing wind should be ascertained so that the smoke ejectors can be situated to work with the wind instead of against it.

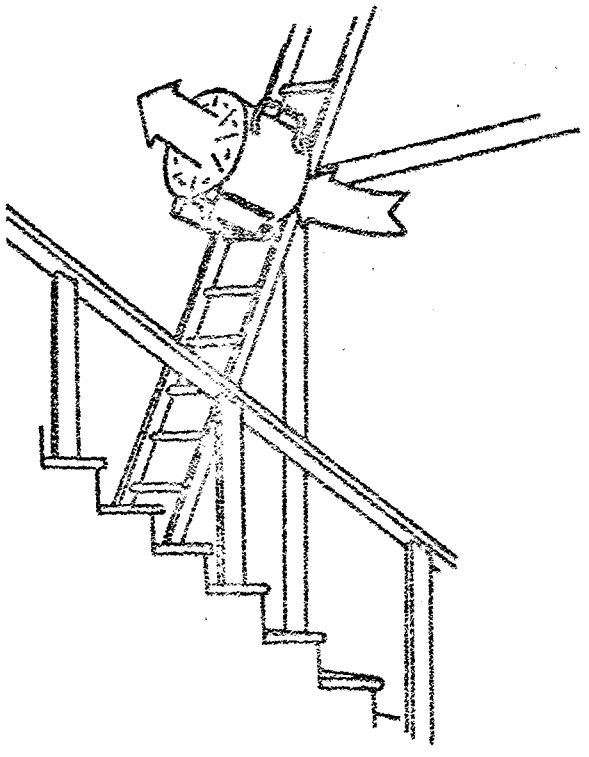
Usually straps with metal hooks attached are used to suspend smoke ejectors in the upper areas of doors and windows. This is because hot smoke and gases tend to rise and so will be picked up and blown out more efficiently by the ejector.

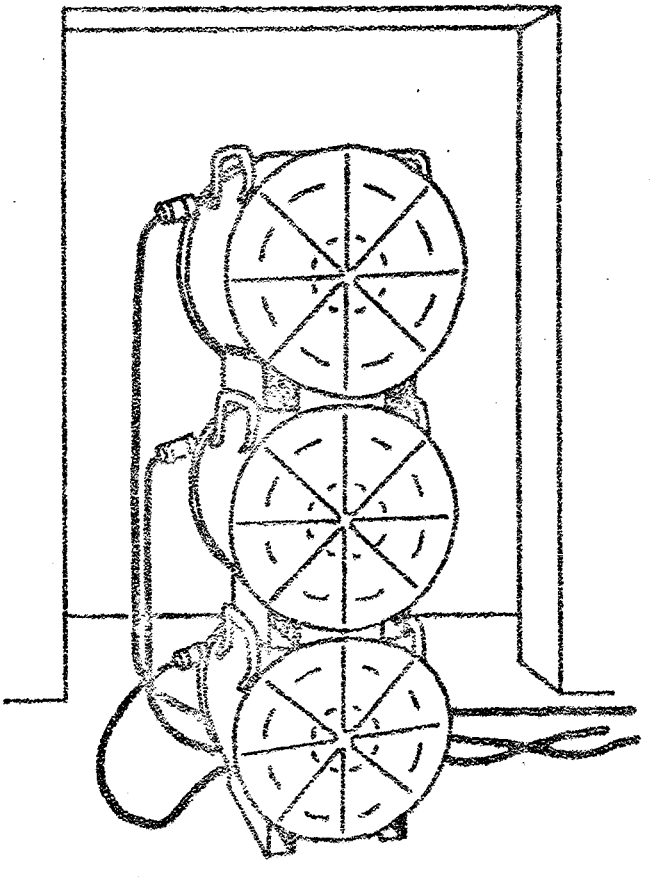












Safety Precautions

Some fan-type ejectors are powerful enough to pickup bits of glass and other debris. This is hazardous not only to personnel, but may damage the fan blades. Therefore, the surface upon which the ejector rests must be clean.

When placing the ejector in a window, the drapes and curtains should first be removed or tied back securely so that they cannot be drawn into the fan blades.

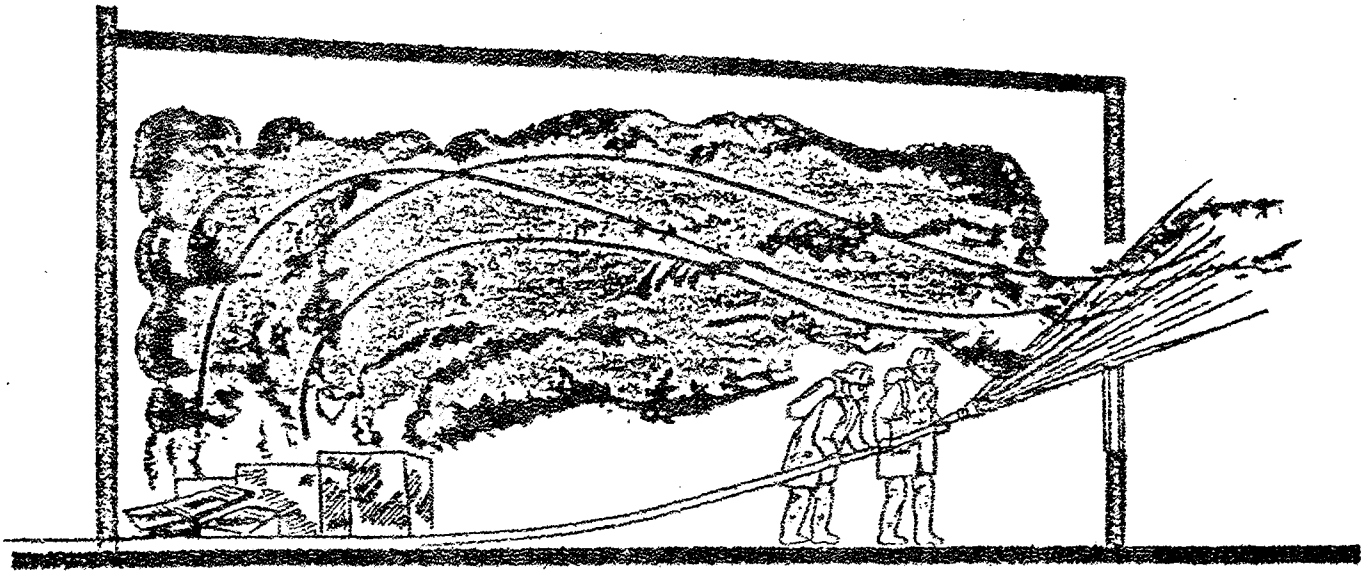
As with any other electrical device, electric driven smoke ejectors should be kept out of the water as much as possible. The power requirements for the most commonly used smoke ejectors range from 500 to 780 watts.

Using fog streams as smoke ejectors:

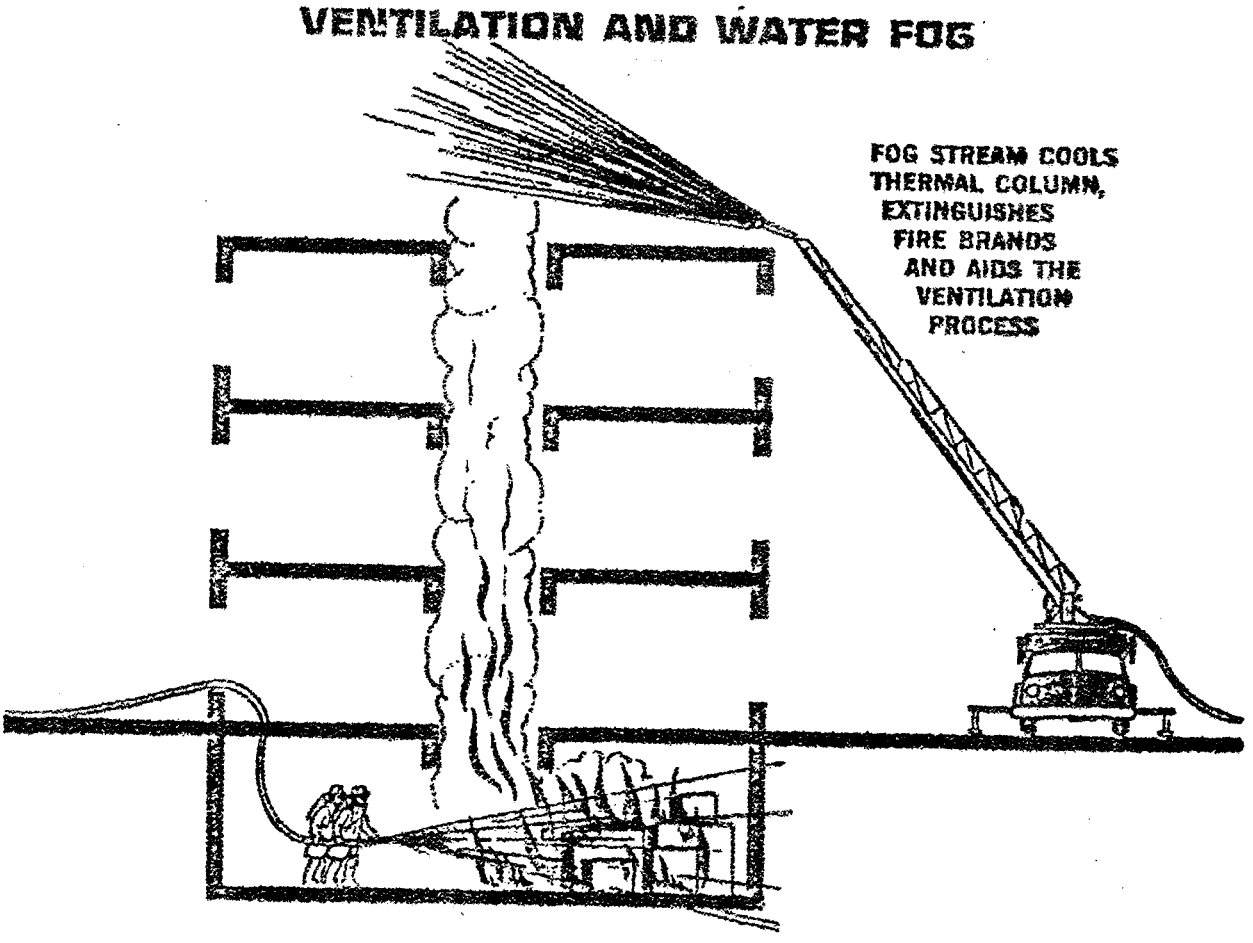
The common fog nozzle is surprisingly efficient when used as a smoke ejector. By creating air currents, it will move 10,000 to 30,000 cubic feet of air per minute depending upon the size, type, fog pattern and location of the nozzle with respect to the vent opening. Fog streams projected through a door or window will move large volumes of air in the direction toward which the stream is projected.

When used as an ejector, the fog nozzle should be held a few feet back from a window or door. The fog pattern should be as wide as possible without the spray touching the sides of the opening. As is the case with the fan-type ejectors, the fog nozzles may be used to both blow fresh air into as well as exhaust contaminated air out of a building.

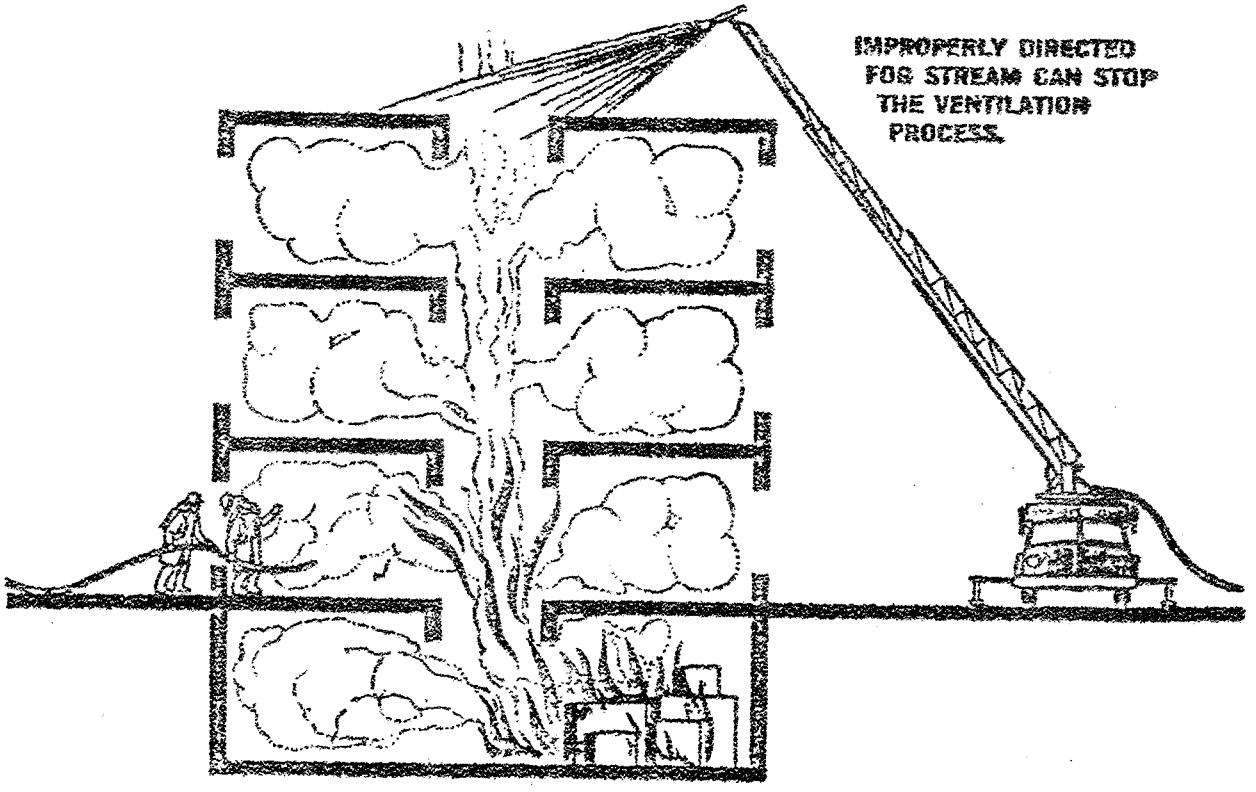
USING FOG TO EXPEL SMOKE AND GAS



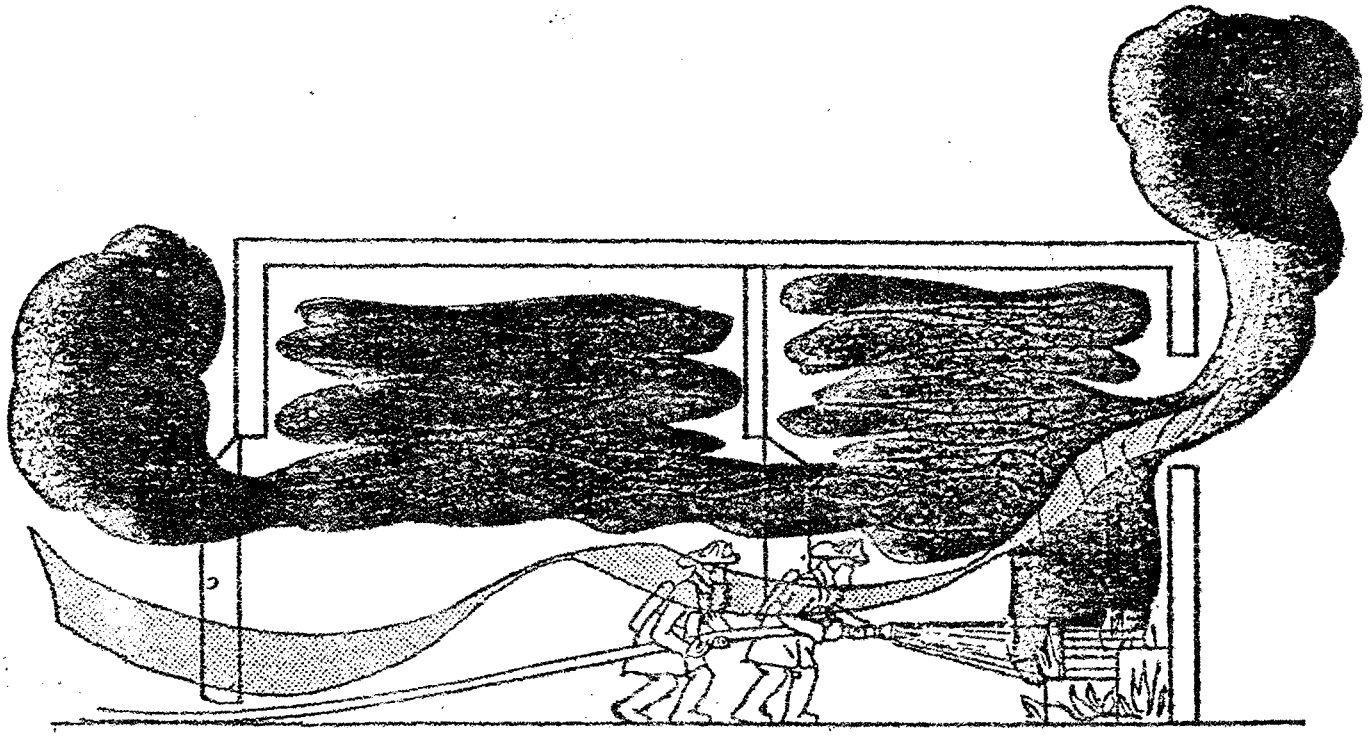
Elevated streams can be used to cut down the amount of sparks and flying particles from a burning building, or to reduce the thermal column of heat over a building. This movement of the stream may increase the rate of ventilation.



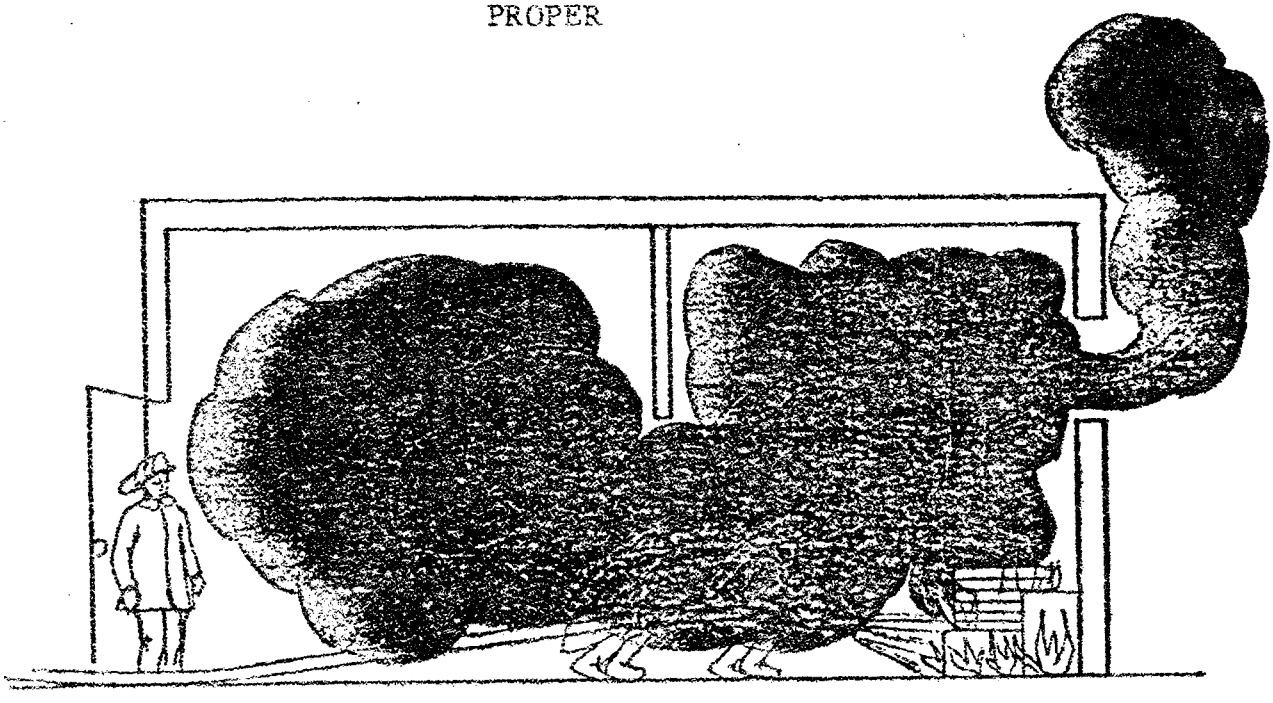
When elevated streams are pointed downwards through a ventilation opening, or used to reduce the thermal column to the point where ventilation is hindered, they either destroy or upset the orderly movement of gases and heat from the building. This may affect the firefighters who are working at various floors below. Thus elevated streams which are used closely above ventilated openings should be projected slightly above the horizontal.



The opening of a door or window on the wrong side of a building may reverse air currents and drive heat and smoke back upon the firefighters. Personnel should be cautioned against opening doors and windows between the advancing firefighters and the established ventilation point, thus blocking the intake of fresh air.



PROPER



IMPROPER

DON'T BLOCK FREE PASSAGE OF AIR.

OVERHAUL

Overhaul operations are primarily concerned with leaving the fire building in a safe condition after the fire has been extinguished. Among the usual overhaul practices are: the search and extinguishment of hidden fires, determination of the cause of the fire, recognition and preservation of evidence of arson.

The results of overhaul are directly valuable to the fire department and indirectly so to the public. There is a hidden value to the public which is often realized through reduced insurance costs, conviction of arsonists, and a quicker return to production schedule.

Proper overhaul involves a systematic handling of contents merchandise, and debris to accomplish many purposes:

- Locates hidden fires so that they may be extinguished, preventing further damage.

- Prevents rekindle. Proper overhaul does not in itself assure that a fire will not rekindle, however it does enable firefighters to detect certain types of materials in which rekindling is more likely than others.

- Determines cause of fire, recognizes and preserves evidence of arson. Proper overhaul will permit some evidence to remain untouched and undisturbed.

- Prevents unnecessary damage through development of routing system.

- Places building in safe condition. Making a building safe can only be accomplished through a thorough knowledge of conditions. The facts concerning these conditions can best be gathered during proper overhaul.

- Improves public relations. Good public relations is measured by the fire department's efforts to cooperate with property owners, law enforcement officers, utility companies, city officials and the public in general.

Overhaul Equipment

Major overhaul must, by necessity, follow after the main body of the fire has been extinguished. The salvage practices that are done before and after a fire will have a direct bearing upon any overhaul that may come later.

Many of the same tools are used in both salvage and overhaul. Overhaul equipment, tools and accessories generally consist of a normal complement of firefighting tools such as forcible entry tools, small hose lines, ropes, lights, and portable extinguishers. Some overhaul equipment may also be segregated and carried in overhaul kits - usually one for arson and another for safety. Overhaul kits should contain materials necessary to perform the intended specific function. When such kits are used, it would eliminate the need to hunt for supplies when a particular job needs to be done.

Overhaul Practices

Subsequent fire control is simply the follow up after the initial extinguishment of a fire to prevent a rekindle. In this sense, overhaul procedures are functionally related to fire extinguishment.

Searching for Hidden Fires

Although overhaul procedures may not necessarily follow a pattern or plan, one of the first operations will almost always be searching for hidden fires. It is considered a bad reflection on the ability of the fire department to have to return to the scene of the fire to cope with a rekindle. It may be true that sometimes a rekindle is due to inadequate overhaul, but there are also conditions where rekindle is due to circumstances beyond the control of the fire department. There are certain situations when complete extinguishment is extremely difficult, and a continued search much be maintained over the fire area for a prolonged period.

The methods of opening areas of buildings where fires may be concealed are covered by the section covering "Forcible Entry". The purpose here shall be to discuss these concealed spaces from the viewpoint of the searcher. Some of the more common concealed spaces in buildings are in walls and partitions, attic, above ceilings and below floors, basements and air shafts and ducts.

Only the more fundamental conditions will be discussed since it would be extremely difficult to outline all of the operations that may be performed in searching for hidden fires.

Before beginning a search for hidden fires, it is necessary to determine the condition of the area of the building to be searched. The degree of intensity which the fire attained during burning and the amount of water used during its control are two important factors that

influence the condition of the building. The first determines the extent to which the structural details have been weakened, and the second determines the additional weight on the floors and walls because of the absorbing qualities of the stock. Consideration of these two factors may prevent, during overhaul, unnecessary loss due to building collapse.

An important objective is to make a systematic and careful check to determine whether the fire has extended to other areas of the building, or to other buildings. If it is found that the fire did extend to other areas, it is then necessary to determine through what medium it traveled. For example, when floor beams have burned away at the ends where they enter a party wall, it is good policy to overhaul the ends by flushing the voids in the wall with water. The far side of the wall should also be checked to see whether fire or water has penetrated.

When the fire has burned around doors or windows, there is a possibility that fire remains within the casings. In order to assure complete extinguishment, the facings should be removed to locate any remaining fire. Insulation material will often harbor hidden fires for a prolonged period and must be removed and checked.

Hidden fires in concealed spaces can often be detected by feeling probable areas with the back of the hand, smelling and evidence of discoloration or smoke. When concealed spaces below floors, above ceilings, or within walls must be opened during the search for hidden fires, the furnishings of the room should be moved to locations where they will not be damaged. Only enough wall, ceiling or floor covering should be removed to assure complete extinguishment.

Too much emphasis cannot be placed upon the importance of searching for hidden fires under debris and around merchandise. Because of the absorbent quality of materials likely to be piled, it is considered the best practice to remove from the building such materials from the building whenever possible. Not only may such materials become a hazard because of the added weight and expansion, but it is frequently difficult to determine the exact location of the fire within the pile. Fallen structural members of a building often form pockets in which fires may smolder.

Extinguishing Hidden Fires

It is essential for firefighters to wear proper protective clothing while performing overhaul. This protection is an aid to the tedious and dangerous work of extinguishing hidden fires. Charged hose lines should always be available during such extinguishment, although the use of the same caliber of hose used to control the fire is not essential.

Quite frequently small burning objects are uncovered during overhaul. Because of their size and condition, it is better to dunk the entire object in a container of water rather than to drench it with a hose. Bathtubs, sinks, lavatories and wash tubs are all useful for this purpose. Portions of burning clothes, pillows, draperies and upholstery may easily be dunked.

Larger furnishings such as mattresses, overstuffed furniture should be taken outside where they can be more easily and thoroughly extinguished. Important: all scorched and partially burned articles may prove helpful to an investigator in preparing an inventory or in determining the cause of the fire.

Removing Debris from Buildings

Non-salvageable material such as wood, plaster, rags, paper and the like may be scooped into a carrier, taken out of the building, and piled in a conspicuous place for future examination. After the bulk of all debris has been removed, excess water on the floors should be mopped or vacuumed.

If the floor is wood, it is good practice to take up excess moisture by covering the floor with sawdust. Damp sawdust should not be left on the floor longer than necessary as it may damage the floor. During the removal of debris from buildings, careful observation should be made for evidence of arson. Should such conditions arouse suspicion, the area involved should be left intact until further investigation has been carried out.

Making the Building Safe

Certainly the first objective in safeguarding a building is the removal of the original cause of the fire. Once the cause has been determined, it may be removed by proper overhaul. Utilities, such as natural or artificial gas and electrical service, should be cut off as soon as possible. The supply lines and wiring should be checked for safety by a utility representative before services are restored.

Another phase in making a building safe is its structural condition. Situations such as loose cornices, bulging walls, sagging floors and weakened roofs should be removed or blocked off with barricades. Conveyors, elevators and escalators should be checked for safety before they are released for re-use. Trained personnel are usually available for this service and should be called.

All of the above, plus the adequate security of posting guards around the premises, are precautions that should be taken if additional disastrous occurrences are to be held at a minimum.

Covering Roofs, Windows and Doors

Covering holes in roofs after fires is a very important overhaul operation for it lessens the possibility of damage to household furnishings from the elements. When it is necessary to cover small holes in pitched roofs, the roofing material should be raised around the hole before the hole is covered. This prevents water from running into the hole. The cover should then be nailed in place. Large holes may be patched with salvage covers by overlapping the covers. Laths or boards should be used to cover the edges.

Skylights are the easiest of all roof openings to cover and make watertight because the skylight framework is usually elevated above roof level. Open skylights should be covered with salvage covers and the edges should be weighed or nailed down.

When covering holes in a flat roof, raise the roofing paper around the hole to a height of 4 to 6 inches and block it in place with some suitable material. This will prevent water from flowing in.

Windows and doors which have been damaged or removed should be covered during overhaul procedures. A good grade of roofing paper makes a satisfactory cover for open doorways and windows. Roofing paper can also be held in place with strips of wood and nails.

Making the Contents Safe

The damaged contents of a building can present serious safety hazards and a careful check should be made to restore these situations to a safe condition. One of the most serious problems concerns materials which have

the capacity to absorb large quantities of water. The absorbed water could add tons of weight to an already weakened floor structure, and it is best to remove the material from the building.

The following items may be loose or unstable and should be checked to determine whether they are safe: overheated fixtures, suspended articles, shelving, hazardous liquids and solids and stock.

Restoring Sprinkler Systems

Firefighters should have a technical knowledge of sprinkler equipment and understand its functions. They must be thoroughly familiar with the particular system most common in their district in order to handle them efficiently when a fire or leakage occurs.

Sprinklers are installed as an aid to firefighters and should be used accordingly. Many sprinklered buildings have been deluged with water because firefighters have improperly handled the control valves. Sprinkler valves may be shut to prevent excessive water loss, but should never be done until it is absolutely certain that the fire is under control. Finally sprinklers should always be placed in service after a fire as protection against rekindling.

Detailed information concerning sprinklers can be found in the section entitled "Sprinklers".

Restoring Standpipe Systems

Standpipe systems consist of large water pipe risers which usually extend from the lower floor of a building to either the top floor or the roof. There are hose connection outlets at each floor and these are usually strategically located for easy access by either occupants or firefighters.

Further information regarding standpipe systems may be found in the section entitled "Standpipes".

SALVAGE

Salvage, as applied to firefighting, is essentially the prevention or reduction of damage from indirect causes such as the heat and smoke generated by the fire, the water used to extinguish the fire, and falling debris and breakage, as opposed to actual burning which is a direct cause.

Efficient salvage operations include not only the prevention and reduction of indirect losses while the fire is in progress, but also the saving and protection of property after the fire has been extinguished.

Some important salvage operations during a fire:

1. Placement of salvage covers to protect furniture, fixtures, machinery and business records from water and debris.

2. Removal of goods or property endangered by fire as well as property threatened by water, smoke and debris.

3. Use of salvage covers to "bag" the floors.

4. Diversion of water from the fire building and use of salvage covers to cover floors and stairways, or to provide chutes necessary to divert water to the exterior of the building.

5. Ventilation of the building to remove smoke and heat.

6. Removal of contents of the building where they obstruct firefighting operations.

Some important salvage operations after the fire is controlled or extinguished:

1. Shutting down of sprinkler systems, replacement of fused sprinkler heads and in-service sprinkler systems.

2. Removal of water from floors and basements.

3. Completion of building ventilation to remove remaining smoke and heat.

4. Removal of valuable articles from debris.
(See HFD Procedures and Manual of Operations)

5. Shutting off of defective or damaged water systems to prevent leakage.

6. Provision of necessary coverage for the roof, windows, and other openings to protect the interior of the building and its contents from the weather.

7. Removal of spread salvage covers.

8. Securing the building against intruders and vandals.

Salvage Equipment

1. Brace and Bit - A tool for boring holes as a starting point for saws, drains, floors, etc.

2. Claw Hammer - Used in hanging salvage covers and when making temporary repairs to roof.

3. Corn Broom - For sweeping water, debris, salvage covers.

4. Ejector - A syphon appliance used for removing large quantities of water from basements, pits, sumps, ships, etc.

5. Master-adaptor - In combination with a garden hose, this device is used for general overhauling operations. It can also be employed to drain a sprinkler system when the drain valve cannot be located.

6. Hay Hooks - A tool for moving or carrying baled material, packing cases, crates.

7. Ladders - Frequently used in the construction of water drains of varying types. For this purpose, straight ladders are preferable over extension ladders. The collapsible and the 16-foot extension ladders are employed in interiors and confined areas when hanging salvage covers.

8. Lights - Battery operated portable spotlights and flashlights are carried by companies for illumination. When general illumination is desired over a large area, the light wagon is used.

9. Mops, Buckets and Squeegees - Used in removing water from floors and floor coverings.

10. Pike Poles - Varying lengths are used in the construction of and bracing of salvage covers and water drains.

11. Roof Covers - These are used to cover holes in roofs caused by fires or firefighting operations and are colored green and treated with an oil base.

12. Salvage Covers - These are used to protect property, merchandise and furnishings, and made of cotton duck measuring 14 x 18 feet. Brass Grommets are placed conveniently along the edges and at the corners for hauling and securing.

13. Salvage Master (Water Vacuum) - A portable device used to scoop water from floors and carpets following a fire. This is usually a six gallon polyethelene tank that can strapped onto the back and is equipped with a flexible hose and 4 ft. suction tube.

14. Shovels - Open scoop shovels are used for scooping up water, picking up debris, etc. Square point shovels are employed in overhauling operations, removing debris, clearing walkways, etc.

15. Smoke Ejector - A gasoline powered blower used to exhaust smoke and gases from confined areas. This may be used alone or in conjunction with the "forced draft" - a newer version of the smoke ejector, which performs the same function.

16. Sponges and Chamois - These are used to remove excess water and to dry finished surfaces.

17. Sprinkler Heads - Broken or ruptured sprinkler heads are replaced with sprinkler heads of the same design. Spare sprinkler heads are carried by the companies, although it is recommended to use the building's own spare heads first.

18. Squeegees- A rubber edged device used to remove water from floors, usually an 18" straight wooden head or 36" crescent metal head with a rubber edge attached to a long wooden or metal handle.

SALVAGE OPERATIONS

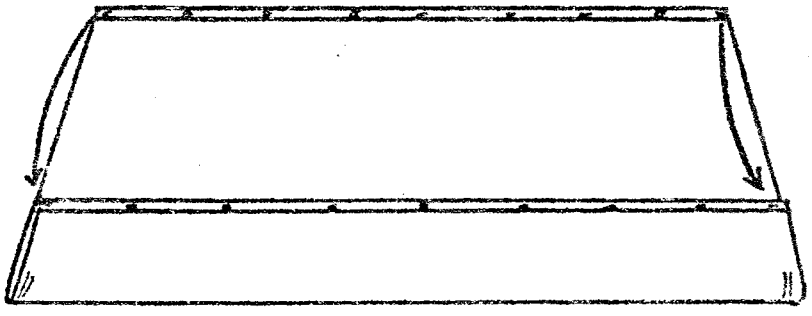
In order to allow for convenient handling and easy manipulation, salvage covers are folded and carried on apparatus in a regulated manner:

Accordion Fold

1. Place cover, finished side up, on a clean surface and smooth out flat.

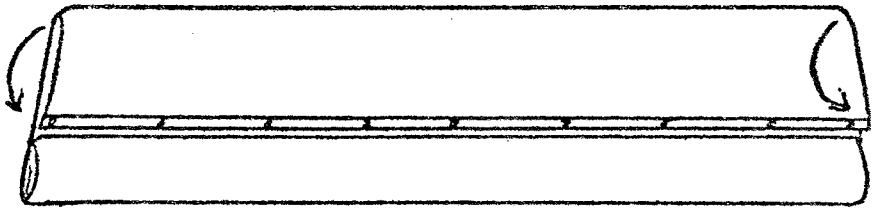
2. Two men take position at opposite ends of cover.

3. Place outside hand flat on end of cover 3 feet in. With inside hands, reach over and grasp corners, then lap over.



4. Repeat operation on opposite side.

5. Place outside hand flat on the end of cover 18 inches in, then with inside hand reach over and grab the outside edge, then fold.



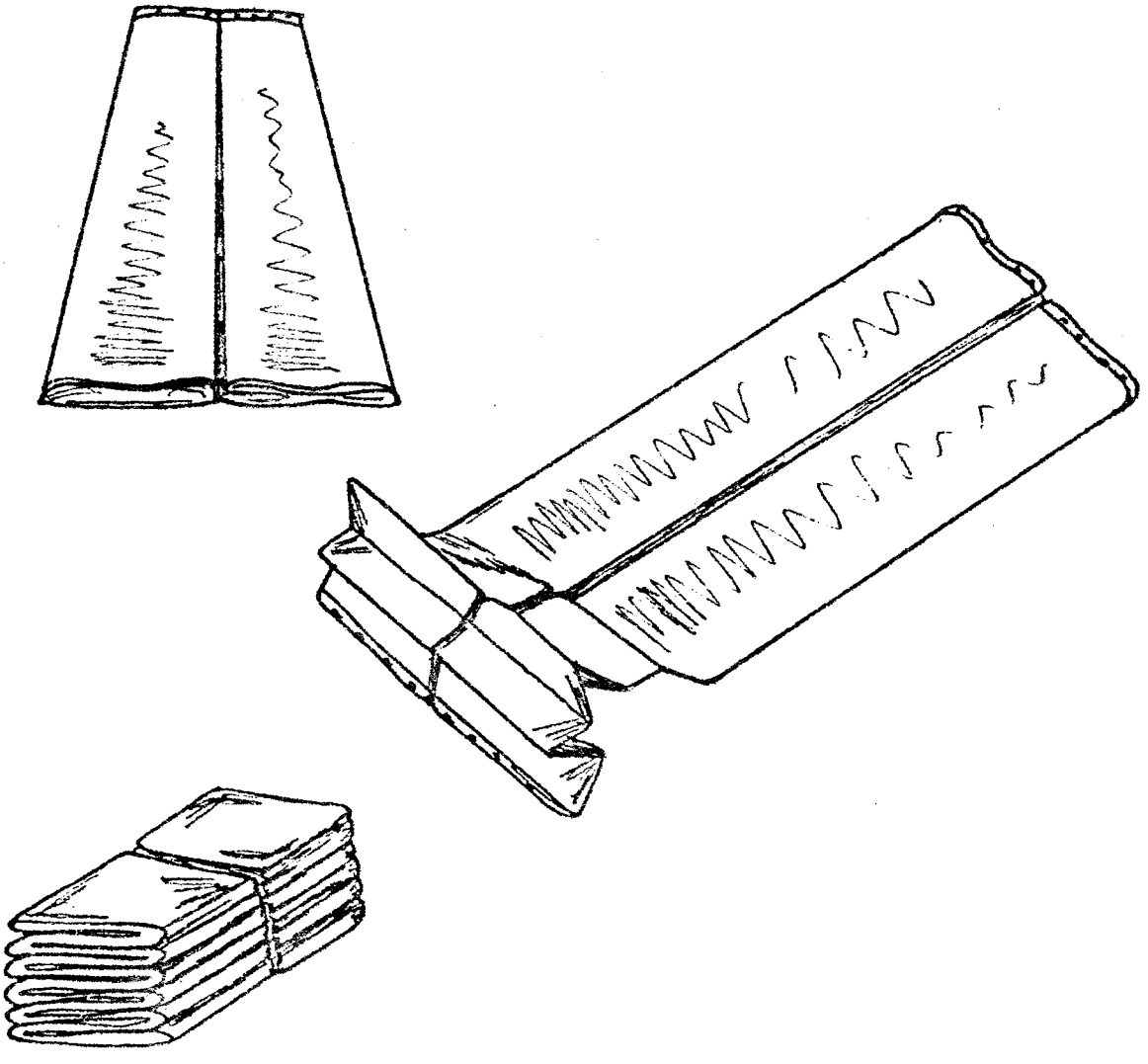
6. Remove air by pushing 2 squeegees down the length of the cover.

7. Men kneel opposite each other at one end of the cover. Place outside hand flat on cover with thumb underneath, 6 to 8 inches in from the end of the cover. Place inside hand, with palm up and thumb on top, under cover 6 to 8 inches from outside hand.

8. Bring inside hand up and over outside hand, bringing fold to edge of cover.

9. Repeat operation until entire cover is folded. Keep all folds even in size.

10. Use a rubber band (cut from an old inner tube) on each end of the cover to keep folds in place.



Carrying

The placement of a salvage cover over the shoulder allows the free use of both hands for climbing ladders, fire escapes, etc.

1. Grasp all folds at end of cover in one hand, pull out and balance center of cover in other hand.

2. Raise and pivot cover over shoulder while maintaining grasp on end. Adjust cover for balance.

3. When carrying two salvage covers at the same time, the second cover can most easily be carried on the forearm on the hip opposite the shoulder being used.

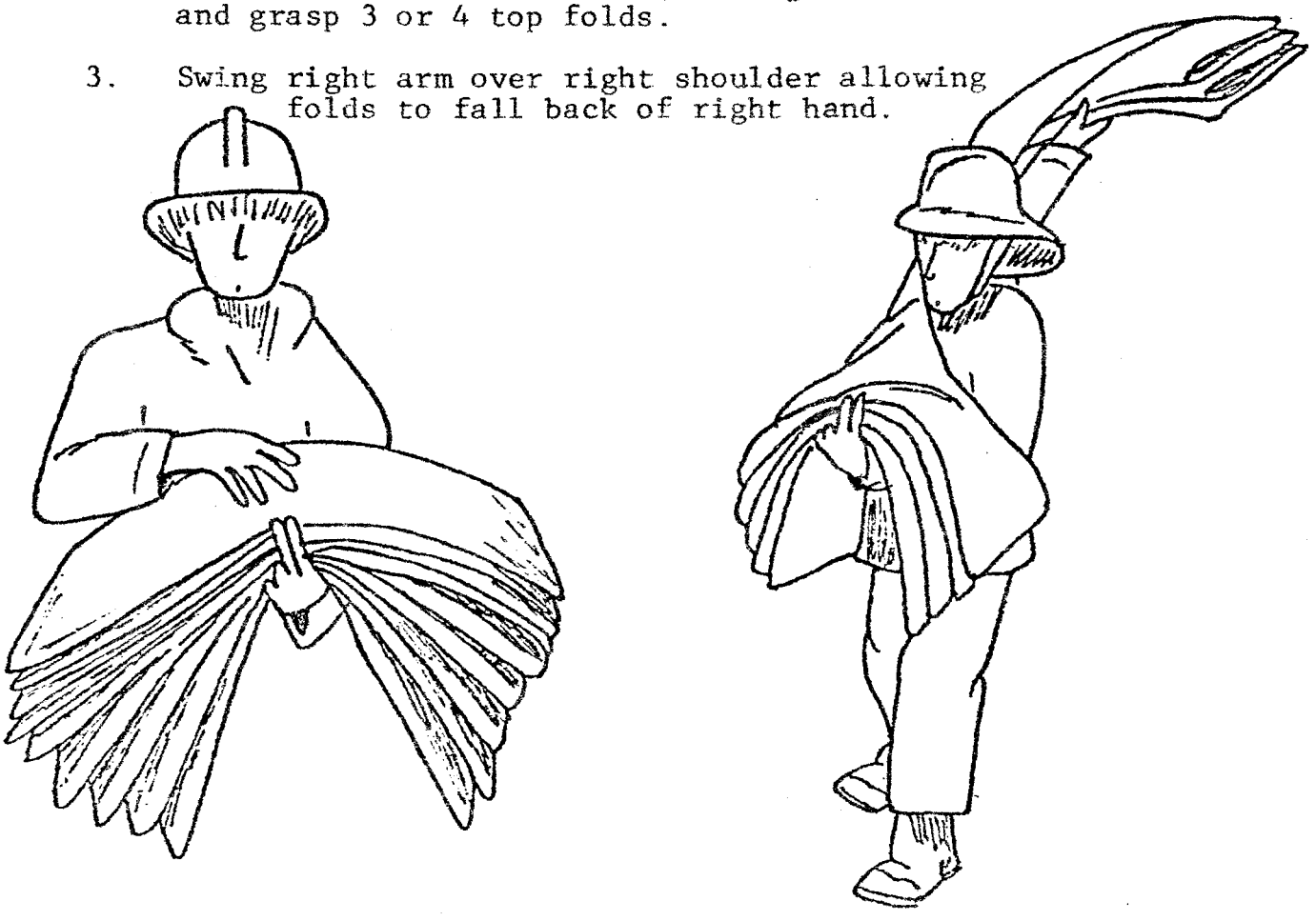
One Man Throw

This is a quick method of covering rolling stock, piles of merchandise or furniture where there is no danger of damage. In making this throw, the use of either arm is optional. The directions given are for a right-handed man.

1. Place center of folded cover over left forearm, grasping bottom fold with thumb and two fingers of left hand. Allow remaining fingers to keep tension on fold.

2. With thumb down, reach in with right hand next to body and grasp 3 or 4 top folds.

3. Swing right arm over right shoulder allowing folds to fall back of right hand.



4. Throw cover as though shot-putting, bringing the hand forward and keeping the arm stiff while throwing.

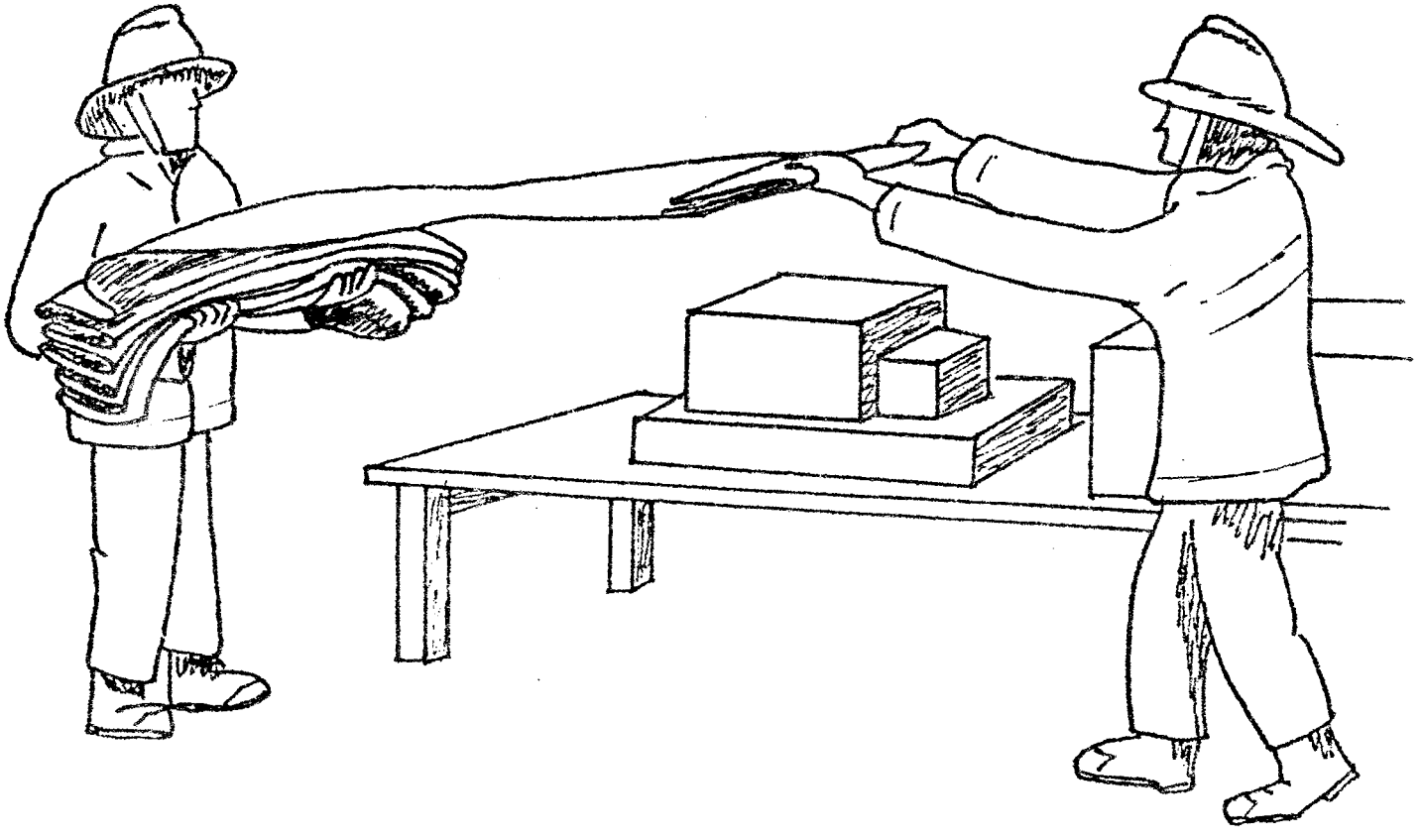
5. Unfold cover. Allow it to drape over object or material. Tuck in cover at bottom to prevent tripping over and to allow water to drain clear of cover.

Counter pay off

This is a two-man operation used where conditions require the careful placement of a cover to avoid displacing or damaging goods. Counters or tables displaying fragile merchandise are best covered by this method.

1. One man holds folded cover over both forearms, grasping bottom fold with both hands, and stands next to one end of the counter or table to be covered.

2. Second man grasps the top fold with both hands, walks backwards until the cover is stretched taut. During this operation, first man elevates his arms to form tension on the cover and to keep it off the floor.



3. Place cover over counter. Lower gently center fold of cover to center of counter.

4. Unfold cover and drape it over the sides of counter.

5. Tuck in bottom edges of cover close to counter to keep aisles free.

Removing Covers from Counters

This method of removal is employed where there is danger of breakage or damage to merchandise on counters, or where the retention of water and debris on top of the covers become desirable.

1. Two men take positions opposite of each other at one end of the cover.

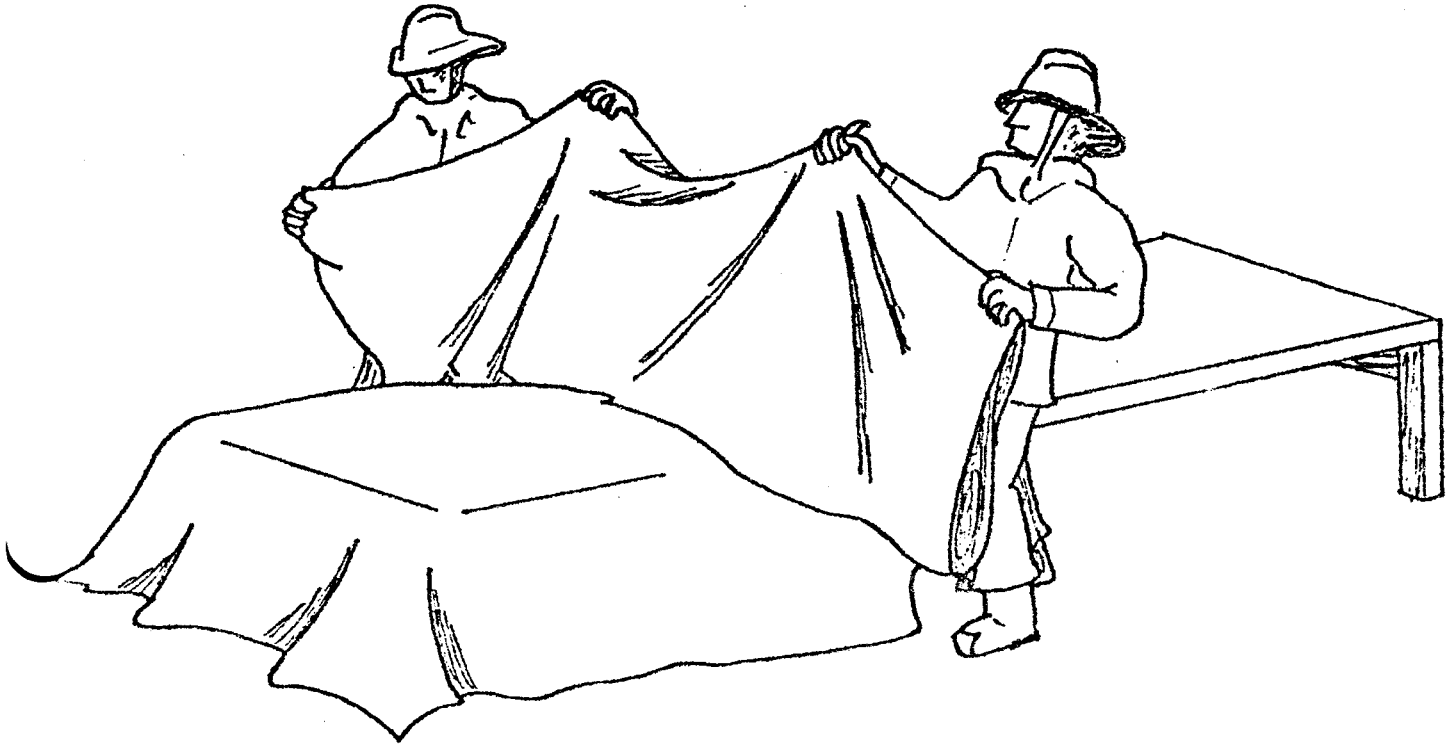
2. Each man grasps end of cover. Both then raise ends overhead clear of counter, walk forward laying raised portion down.

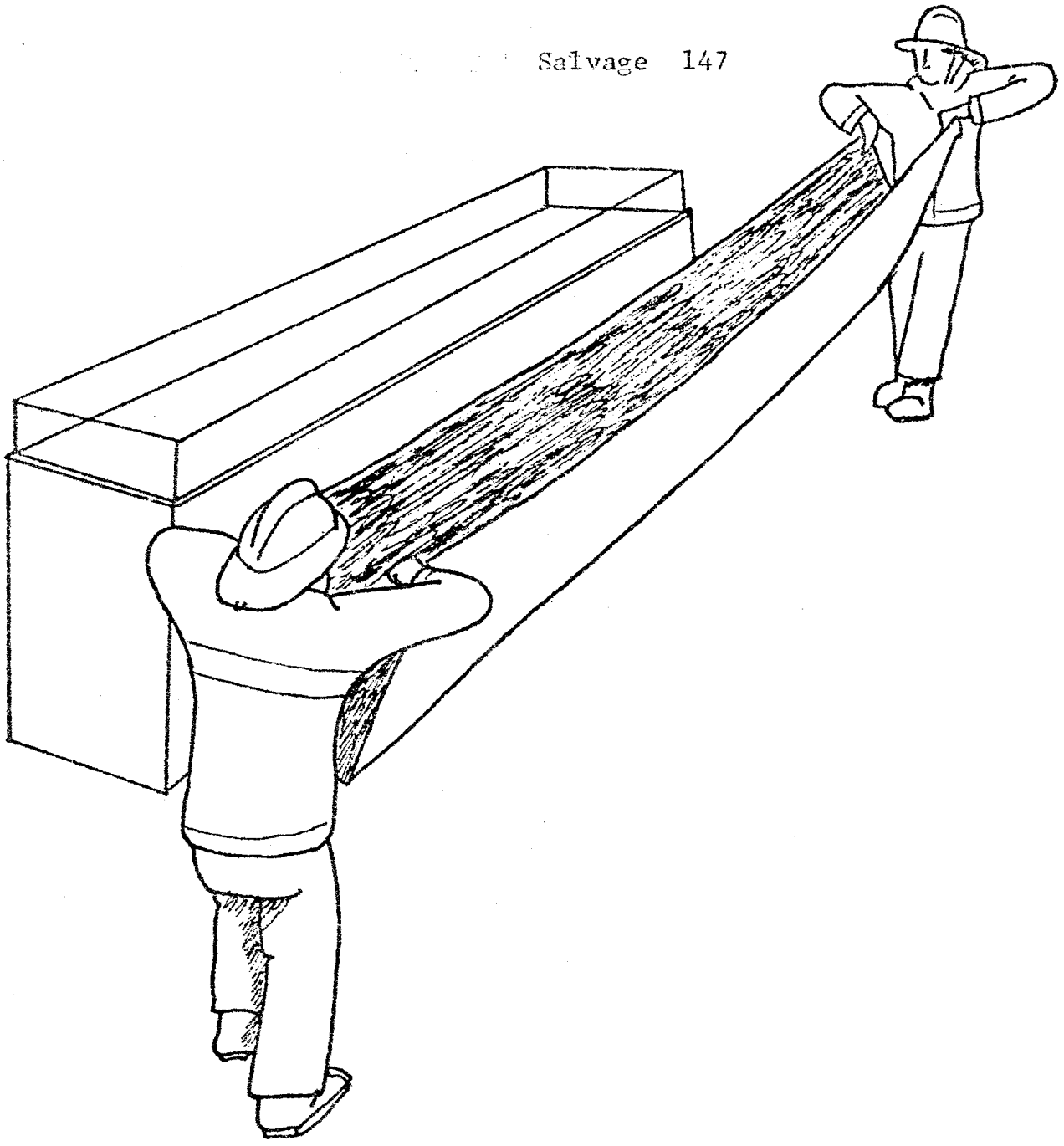
3. Lay over again, continue making folds until almost the end of the counter.

4. When it is almost to the end of the counter, both men grasp the other ends of cover and lap over other folds.

5. One man places portions of folded cover over his shoulder, turning his back to the counter at the same time.

6. Man on opposite side of counter grasps folds, raising cover clear of counter. He then places folds on first man's shoulder, keeping water trapped during process.





TWO MAN BALLOON

This method is used to cover piles of merchandise or objects over which there is plenty of head-room to float a cover. This allows for the complete covering of materials with less operation and can be used effectively if the top of the object or material to be covered is within reach.

Two-man balloon

1. One man holds folded cover with both forearms, grasps bottom folds with both hands.

2. Second man grasps top fold with both hands, walks backwards until cover is stretched taut. During this operation the first man raises his arms to from tension on the cover.

3. Both men grasp both folds and both seams with one hand. Bring other hand up and grasp 1 fold and seam in each hand, keeping hands close together.
(Existing position should be: center of cover hanging down, seam being held by thumb and forefinger, fold being held by ring finger and little finger.)

4. Both men turn cover so the double fold is up and the center of the cover is hanging down.

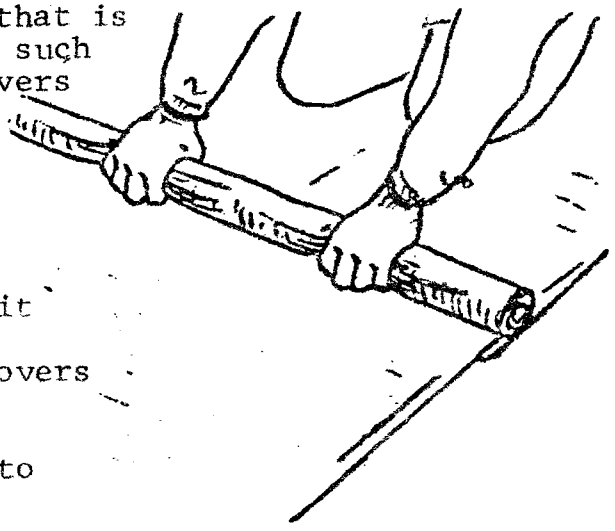
5. Both men pull cover taut, feet well braced, elbows high, palms down. Foot away from object should be used to step forward.

6. Both men snap cover up quickly so that air can get underneath and form a balloon. Let go with outside hands. Float cover over materials with inside hands.

7. Drape cover over object, tuck in at bottom to keep aisles free.

Sealing

Where numerous covers are required to protect large areas, it becomes necessary to seal such covers where they overlap. If a proper seal is not made, damage to merchandise may occur caused by water running between the covers. Sealed covers are usually used on merchandise that is not easily damaged otherwise, or such that careful placement of the covers is not required.

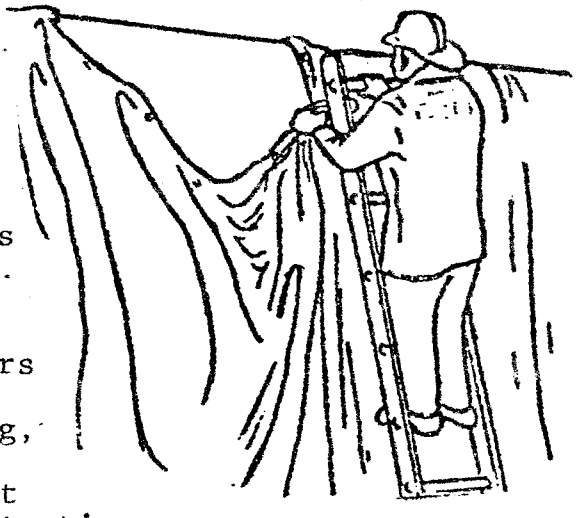


1. Turn the end or side of the spread cover back about one foot.

2. Grasp adjoining cover, pull it over the one foot lap of the first cover until edges of covers are even.

3. With the men equally spaced to each other, grasp both edges and roll until the one foot lap is completely rolled.

4. Continue with the next set of covers, working in a straight line, repeating above operations.

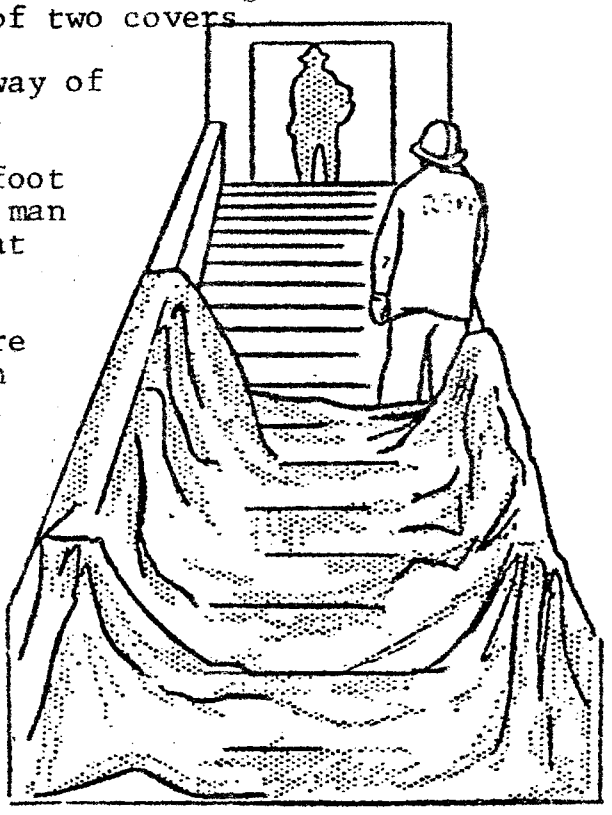


Hanging

In protecting merchandise stored on shelves or racks, hang covers by means of salvage cords, chains, hooks or nails placed through the grommets. Weights placed along the top edge of a cover can be used to hold it up in place. Where possible, hang covers at a point higher than the shelving. Where shelving extends to the ceiling, fasten covers to the top of the shelving. Allow covers to overlap at least one foot to prevent water penetration.

Stairway Drain

This is a method of directing water from upper floors to a point of drainage. The number of covers used is dependent upon the length of the stairway. Directions given are for a stairway which requires the use of two covers.



1. One man carries cover to midway of stairway and lays cover down.

2. Second man carries cover to foot of stairs and using the "one man throw", tosses cover to man at center of stairway.

3. Both men open cover and secure it to handrails or walls with hooks, nails or salvage cord.

4. First man goes to top of stairway with his cover. Second man goes to center of stairway.

5. First man, again using "one man throw" tosses cover to second man.

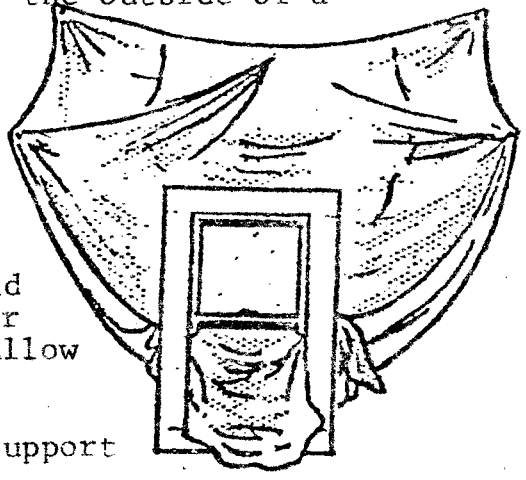
6. Both men open cover and secure it to handrails or walls with hooks, nails or salvage cord.

(The upper cover must overlap the lower cover. The top edge of the upper cover should be placed beneath the lip of the top step. If the top step has no lip, place cover on step and secure.)

NOTE: Carpetrollers may be used when protection of the stairway surface is all that is necessary. (i.e. when water is not a problem, but dirt and debris are.)

Window Drain

When leaks are in close proximity to a window, this drain can be used to direct water to the outside of a building.



1. Fasten center grommet of cover to window sill, finished side up, then fasten remaining grommets on the same edge of cover to the window frame.

2. Pull cover taut. Secure ends and sides by means of hooks, nails or cord under opening in celing. Allow a slight sag so a chute forms.

   Pike poles also can be used to support the sides of the cover.

Pike Pole Drain

This is another method of directing water to the outside of a building when leaks in ceilings are in close proximity to a window.

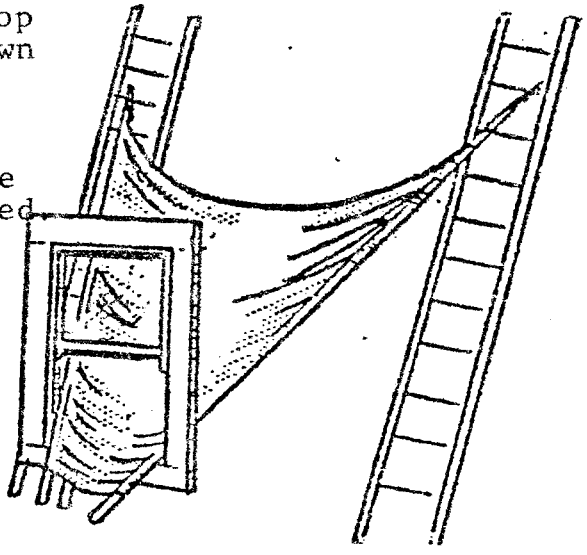
1. Spread a salvage cover out flat, finished side up.

2. Lay two pike poles along opposite sides at any desired angle. Allow handles to extend past cover.

3. Insert points of hooks through top grommets. Fold edge of cover down enough to clear hooks.

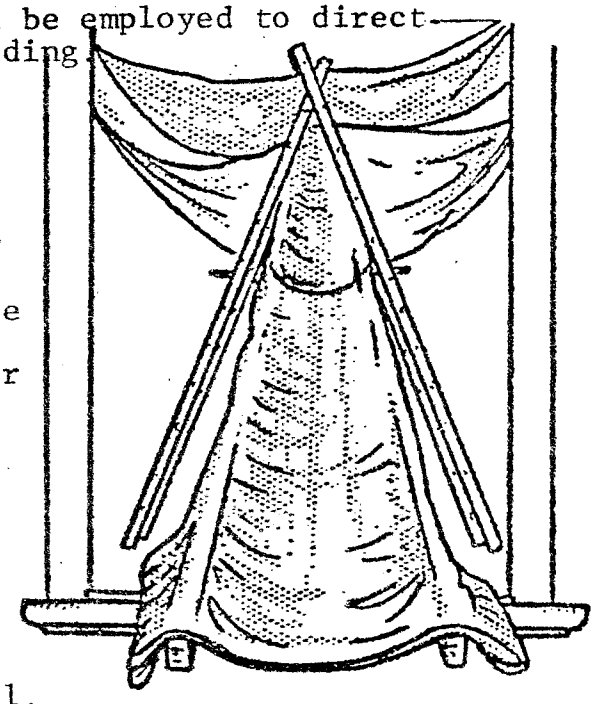
4. Lap cover over pike poles. Roll poles and cover toward the middle until the desired width is reached.

5. Place handle end of drain out of window. Fasten upper end by placing pike pole hooks over rungs of ladders, pipes, high pieces of furniture, or by driving points of pike poles into ceiling.



Window Drain with Ladder

Where leaks in ceilings occur some distance from a window, this type of drain can be employed to direct water to the outside of a building.



1. Place a straight ladder so one end extends over window sill. Fasten.

2. Place other end of ladder under opening in ceiling. Support ladder at an angle by securing it to an improvised step ladder, or by placing it on a high piece of furniture.

3. Place a salvage cover, folded accordion width, on straight ladder, parallel with rungs. Unfold pleats lengthwise of ladder starting at end extending over window sill.

4. Secure cover to ladder with salvage cord at frequent intervals.

5. If necessary, place second cover in similar manner, allowing it to overlap the first laid cover.

6. Hang third cover by means of hooks, nails or cords to form a chute under opening to guide water into the prepared trough.

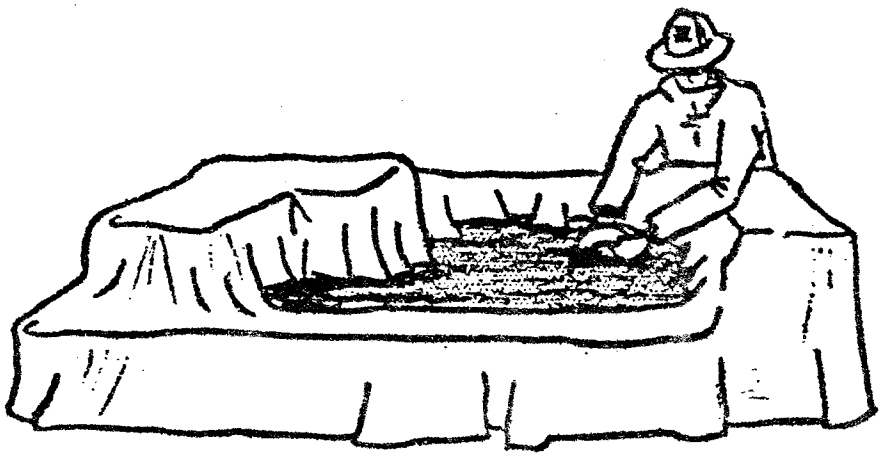
Catch All

This is a method of using a salvage cover to impound water leaking through ceilings that cannot be directed to the outside of a building by means of the above-mentioned improvised drains.

1. Place objects such as chairs, sofas, benches, etc. in position to form a square or circle.

2. Place cover over assembled material, finished side up. Allow center of cover to bag and outer edges to drape over formed square or circle. Tuck in at bottom.

A salvage cover can also be held in place by means of hooks, nails, cords or by rolling the edges of the cover. Water is removed from a catch-all by syphoning, or by bailing with buckets, or covered scoop shovels.



Electric submersible pump and Water Vak-

Circumstances may prove normal drainage facilities as well as the above methods of removing water to be inadequate. In order to reduce water damage, the electric submersible pump and Water-Vak are essential for the removal of excess water from basements, cellars, manhold, and other confined areas.

The Water-Vak is an electrically operated vacuum unit designed for specifically removing surface liquid in a rapid and efficient manner. The Water-Vak should not be used to remove flammable liquids.

The electric submersible pump can safely remove larger amounts of water. This type of pump is usually a small portable electric pump which may be completely submerged in water. The principle precaution to observe in the operation of this pump is not to submerge the cableswitch below the surface of the water.

Sewer pipes -

Vertical sewer pipes can be utilized to drain excess water from floors and basements by removing the cleanout plug and placing a guard over the opening.

Toilet bowls -

The removal of toilet bowls provides an excellent drain at floor level, particularly where the use of other methods of draining are impractical.

1. Shut off water supply to toilet bowl.
2. Disconnect flush pipe at rear of bowl.
3. Remove nuts from studs at base of bowl.
4. Rock bowl gently to break putty sealed joint at base.
5. Remove bowl, place guard over opening.

Scuppers -

Scuppers are found in some of the newer buildings. They are openings through the exterior wall, and are installed at floor level for drainage purposes. If clogged with debris, they can easily be cleared by poking some object as a broom handle, spanner, etc., through them.

Maintenance -

Covers which have been used are to be thoroughly washed in plain water, with the aid of a corn brush if necessary, then hung to dry in the hose tower. In order to prevent out-of-shape covers, they should be hung with their edges absolutely even. When dry, covers should be inspected for holes, rips, tears, and if in good repair should be folded, ready for use.

FIREBOAT

Introduction

No attempt has been made to extensively cover every item of importance of the fireboat, "Abner T. Longley", especially those items explained in other training sections. Instead an attempt has been made to give a broad picture of the differences, rather than the similarities between fireboat and land firefighting equipment.

The "Abner T. Longley" was built by the Albina Engine Machine Works of Portland, Oregon and put into service in 1951 at a cost of $215,293.30.

Dimensions

It is an all-metal boat 87 feet in length, with a 19'9" beam, a 5-foot 10-inch mean draft and a gross weight of 130 tons.

Speed

Maximum speed is 13.43 knots or roughly 15.46 miles per hour.

Power

Power for the propulsion and pumping equipment of the fireboat consists of six 165 HP GMC 6-cylinder Diesel engines. The four engines grouped together approximately amidships are used to drive the single propeller of the fireboat, or to power the auxiliary pumps. The two other engines, one located on either side of the above grouping are exlusively used to operate the vessel's two main stage pumps.

Pumping Equipment

The pumping equipment of the fireboat consists of six pumps. Each pump has a rated capacity of 1500 GPM. When all six pumps are operating simultaneously, there is a maximum discharge of 9000 GPM.

Outlets

Situated amidships is the Manifold which has eight gated 3-1/2 inch outlets. These outlets are swiveled so as to swing in a horizontal arc of 360 degrees for ease of hose connection and manipulation of hose load. Four of these outlets are each topped with a three-way 2-1/2 inch gated valve. Each of the remaining four outlets is provided with a 3-1/2 inch cap.

There are also four 2-1/2 inch gated outlets located at the forward bulkhead of the wheelhouse. These outlets however, are fixed parallel to the deck and are not designed to swivel. Provision is also made for the discharge of mechanical foam from engine room facilities, as well as water, to hose connected to any or all of these four outlets.

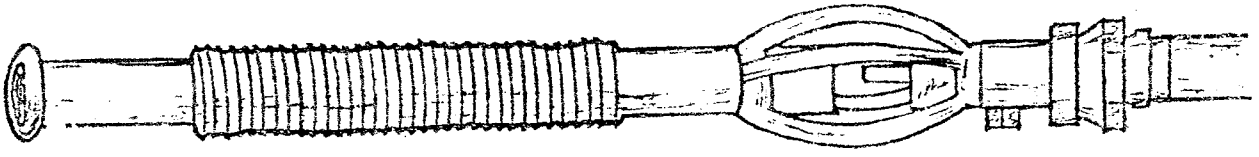
Finally, there are two 1-inch outlets fixed to each side of the aft bulkhead of the wheelhouse to accomodate the booster line.

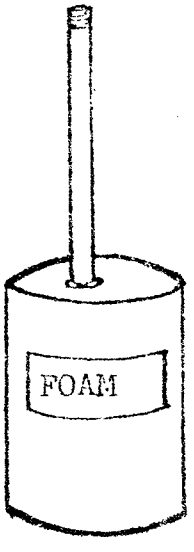
Monitor Equipment

Monitor equipment of the fireboat consists of four deck monitors and one water tower monitor. Each monitor is provided with geared wheel handles for control of the vertical and horizontal movement of the nozzle, and with a gated supply valve. The locations of the deck monitors are as follows: one on the foredeck, one on top of the wheelhouse and two at the stern of the vessel. The water tower monitor is located approximately amidship aft of the wheelhouse.

Foam Equipment

The fireboat has two methods of producing mechanical (6%) foam for the extinguishment of class B fires. One consists of the portable pickup aerofoam nozzle. The other is a fixed installation whereby foam is supplied from engine room equipment to the four outlets at the forward bulkhead of the wheelhouse for use with handheld foam generating nozzles.





The fixed foam equipment is installed in the engine room and includes a proportioner and two 500-gallon tanks of 6% liquid foam, with a foam capacity of 16,000 gallons. The pumping system supplies water under pressure to the foam. Air is added to the water-foam mixture within the special nozzle used, thereby creating a thick blanket of foam.

For smaller fires, where it is necessary to use the large foam tanks, there is the portable pickup nozzle which is a combination pipe, hose and tip. Operation of the foam nozzle consists of connecting the nozzle to a hose line, which in turn is attached to a pickup tube, and placing the pickup tube in a 5-gallon container of liquid foam. Two 5-gallon containers of liquid foam are carried on the fireboat. When water under proper pressure is supplied to the nozzle, mechanical foam will automatically be produced and discharged by the nozzle tip.

Carbon Dioxide Equipment

The fireboat is equipped with a CO_2 fire extinguishing system which provides for Class B and C fire extinguishment on vessels or at waterfront facilities. A hand-controlled nozzle connected to a 300-foot, 1-inch hose is wound on a reel installed on the after deck. Carbon Dioxide is supplied to the nozzle through a piping system connected to a manifold of five 100-lb. CO_2 cylinders installed in two banks on the port side of the after deck. Either bank may be used by pulling the appropriate lever. When one bank becomes empty, it is necessary to turn off the individual tanks before switching to the other bank.

The use of carbon dioxide equipment on shipboard is subject to limiting factors:

> Carbon dioxide gas is 1-1/2 times as heavy as air at ordinary temperature and atmospheric pressure. It is odorless and colorless. Carbon dioxide, like any other inert gas, may cause suffocation due to oxygen deficiency, if high concentrations are breathed in for an extended period of time. The protective use of self-contained breathing apparatus is therefore mandatory for firefighters using CO_2 in confined shipboard areas, or if it is necessary for men to enter a confined area in which CO_2 has been discharged.
>
> Carbon dioxide is ineffective for the extinguishment of cargo that contains enough oxygen to support its own combustion, e.g. celuloid. CO_2 extinguishment of cargo fires that contain a certain supply of oxygen such as carried in the spaces between cotton fibers, is often difficult unless sustained total flooding can be maintained.

It is often difficult to cause CO_2 to penetrate cargo in a ship's hold such as the center of smoldering, tightly packed bales or to penetrate spaces blocked off by cargo.

The use of CO_2 near the top of a ship's hold will not necessarily be an effective extinguishing agent due to its tendency to mix or diffuse with air. There is no tendency for CO_2 to separate from air and act as an extinguishing agent once it has diffused into the air and has become a stable mixture with it.

Oxy-Acetylene Cutting Equipment

The fireboat is provided with a medium sized oxy-acetylene cutting unit complete with all necessary attachments.

The acetylene cutting unit is a very necessary part of fireboat equipment. At many ship fires it may be necessary to cut holes through metal decks, bulkheads or the hull in order to reach the fire with hose streams and circulators. It is not unusual that holes must be cut in hulls to release flooded upper deck spaces to prevent the vessel from capsizing. Often it is necessary to burn off door hinges or locks as well in order to facilitate rescue operations.

Before beginning any oxy-acetylene cutting operation aboard vessels, the officer in command should consult with other responsible personnel aboard who are familiar with the construction of the endangered vessel and her cargo. Their advice is essential to avoid further aggravation of the dangerous situation.

Generators

The fireboat is equipped with two Buda Diesel Generators. Each is rated at 6 KW (110 volts D.C.). Only one electric plant is required to operate the electrical system. The other plant is used as a standby only.

Hose

The hose capacity of the fireboat is as follows:

The large reel located immediately aft of the manifold contains 1,000 feet of 3-1/2 inch hose. In addition, two full bundles (400 feet) of 1-1/2 inch hose are stored on top of the reel. 200 feet of 1-inch booster line are kept on another smaller reel on the starboard side of the wheelhouse. The reels are covered with form-fitting canvas covers to protect the hose from the weather. The remaining hose, 1,000 feet of 2-1/2 inch, is located on a reel which is located immediately aft of the wheelhouse.

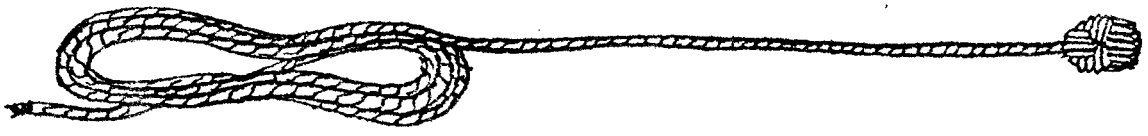
Ladders

The fireboat carries only two portable ladders. Both are made of aluminum. One is a straight beam ladder 25 feet long. The other is a 7 foot ladder with two large iron hooks on the top end which can be used to hook onto docks and other vessels for boarding purposes.

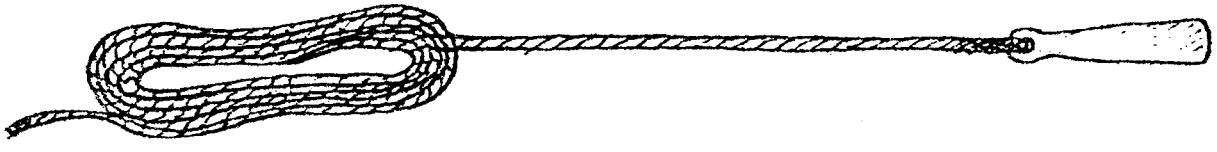
Lines

The fireboat carries various sizes, lengths and types of lines necessary for its own safety, safety of other craft and for the quick and efficient performance of the duties required.

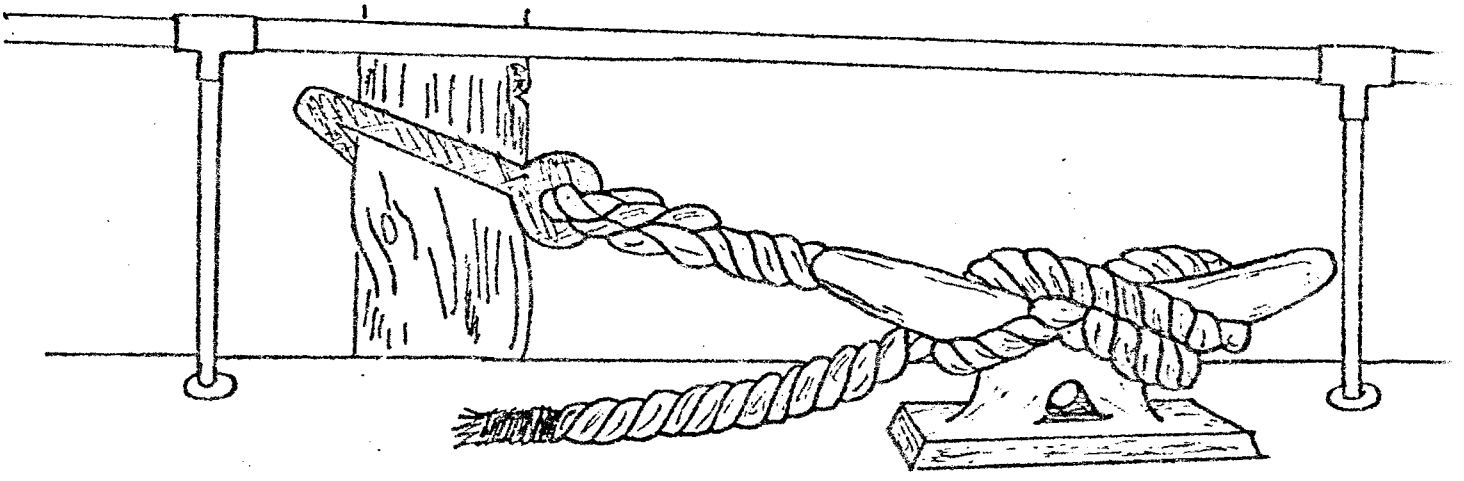
Heaving Line is a 3/8 inch line, approximately 150 feet long, and weighed on one end with a 1-pound ball. If a hose line or tie-up line is needed ashore or on dock, and if the fireboat cannot maneuver close enough, the heaving line is cast first and the other end of the heaving line is tied to the item needed. The heaving line is then pulled toward the shore or dock bringing the needed item with it.



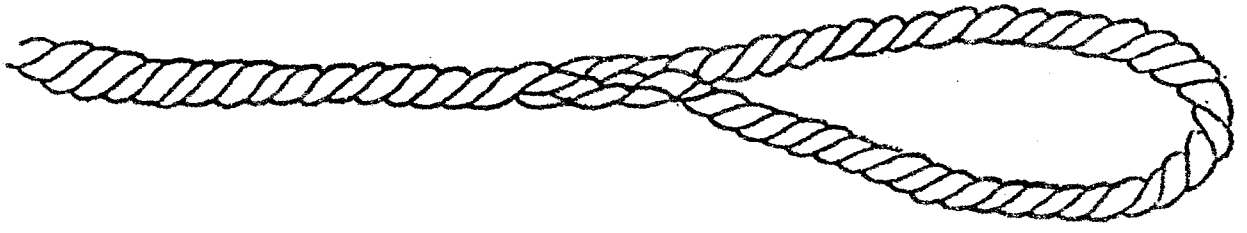
Lead Line is a 3/8 inch line, approximately 100 feet long with an 8 pound lead weight secured on one end. It is periodically marked with strips of leather at various intervals so that by dropping it over the bow, the exact depth of water can be determined. The lead line is the most dependable method of measuring the depth of water at the bow in locations that are extremely treacherous.



Landing Line is a 3 inch line, approximately 35 feet long. It has a heavy hook on one end and a 3 foot loop on the other. When approaching a dock, the iron hook is hooked into (or around) the closest piling and the line is wrapped around the cleat, letting the line slowly slip until the boat has stopped. The line is then wrapped around the cleat several times until the stern is close enough to secure with a stern tie-up line.

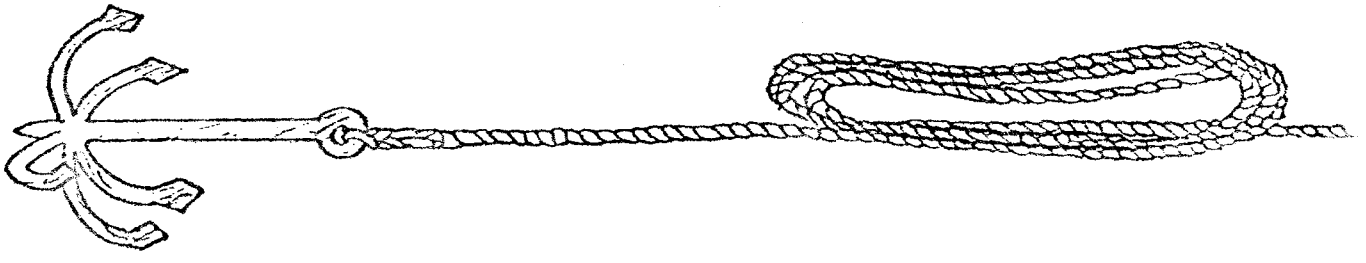


Mooring Line - There are three mooring lines: 1 stern line, 1 bow line and 1 spring line. These are 5-inch lines approximately 10 feet long. Their purpose is to secure the boat to the dock at the station.



Grappling Hook

This is an iron hook approximately 2 feet long having five curved claws on one end and an eye connected to 75 feet of 3/8 inch line on the other. It weighs 8 pounds and is used to locate and raise submerged objects or bodies.



Lifeboat

It is all-fiberglass, 10 feet in length with a 4-foot beam. It is powered by a 6 HP Evenrude outboard motor. The boat is used for rescue work as well as to facilitate fire-fighting under docks.

Scuba Firefighting Monitors

Wharf fires have a great potential for destructiveness. The excessive areas of wooden construction, the lack of fire breaks and sprinkler protection and the general inaccessibility of the substructural area make fire control operations extremely difficult. A city with an extensive waterfront system developed for marine transportation with docks, piers and warehouses must guard against the spreading of fire from pier to pier and pier to ship.

As with all fires, the objective at a wharf fire is to confine it to the point of origin. This is difficult where there is heavy decking above the fire with girders and beams below to impede the fire streams from land apparatus and the fireboat. In a large percentage of underwharf fires, the inability of firefighters to bring effective streams to bear on the seat of the fire constitutes the primary problem.

In order to successfully confine such a fire, the fireboat and land apparatus can be used in conjunction with lines connecting the apparatus to the SCUBA Firefighting Monitors.

The SCUBA Firefighting technique is a unique and highly effective method of containing and extinguishing substructural fires. This system of attacking substructural fires with water-borne fire streams produces excellent results which would have been extremely difficult to control with conventional methods.

The time required to reach the seat of a substructural fire frequently determines whether it will be extinguished in its incipient state or develop into a conflagration. An impressive aspect of the SCUBA technique is the speed with which it can be put into operation. Water curtains can be positioned in a fraction of the time previously required.

Many of the flammable liquid type of wharf fires are due to the creosote impregnation of the substructural timbers. Creosote is an oily transparent liquid obtained through the distillation of coal tar. When heated, it emits toxic fumes irritating to the eyes, skin and respiratory tract. The vapors are heavier than air and higly flammable.

As an underwharf fire develops, its burning characteristics will be directly related to air movement in the substructure area.

Usually at first, an underwharf fire will be confined to a small area and will burn freely. The area in the immediate vicinity will be tenable, but the presence of considerable grayish-white smoke will necessitate the use of breathing apparatus. As the fire intensifies, the creosote in the surrounding timbers will vaporize and produce a heavier, blacker smoke.

Strong air currents in the underwharf area may cause the fire to spread rapidly. When wind velocities are low, the fire may produce its own air currents.

Due to a restriction of air currents, flame production may be limited but heat will continue to build. There will be a marked increase in the concentration of vaporized fuels. Prolonged burning under these conditions will produce extremely high temperatures and a large portion of the substructure may become charged with flammable gases setting it up for rapid flame spread.

If the obstructions are removed and air currents reach the substructural area, rapid flame propagation will result. Fire spread may be extremely rapid and the entire substructure may become involved in a matter of minutes,

Operating Procedures of SCUBA Firefighting Monitors:

Fireboat procedures:

1. Fireboat officers shall determine the lengths of 2-1/2 inch hose necessary to reach the fire, allowing additional lengths to be advanced if necessary.

2. Fenders (floaters) shall be placed as follows:

   - one 6-feet from shut-off on monitor
   - one at center of each length of hose
   - one at each coupling connection

3. Shut-offs (2-1/2 inch) are connected at each 2-1/2 inch female coupling on monitor.

4. Nozzles (2-1/2 inch) are connected to the top of 2-1/2 inch male connection or as directed by rescue officer.

Rescue Squad Procedures:

1. Rescue squad officers shall check that divers are suitably dressed in proper diving equipment.

2. Divers shall work in pairs using the "buddy" system.

3. Other divers shall assist in advancing hose when directed.

4. Divers shall be aware of distance of fireboat from the fire and from any other boats in the area.

5. Officers shall coordinate and supervise men and apparatus

SCUBA Monitors

The fireboat is provided with four SCUBA Firefighting Monitors, each approximately measuring 6" x 24" x 42". The monitors are built from a block of polyurethane foam with rounded edges and corners. There is a 2-1/2 inch copper tubing connected with a tee and centered on a male 2-1/2 inch fitting at one end. The other end is fitted with a 2-1/2 inch female swivel. The hose nozzle is connected to a male 2-1/2 inch fitting which is centered in the float. The total float is then covered with fiberglass and resin with a yellow finish coat.

Propulsion for the monitor is accomplished by using the nozzle's reaction force. To proceed forward, a diver depresses the back of the monitor with his body weight to change the angle of water discharge from the vertical. Similarly, reverse propulsion is done by depressing the front end of the monitor and sideways propulsion by depressing the opposite side of the monitor from the direction desired.

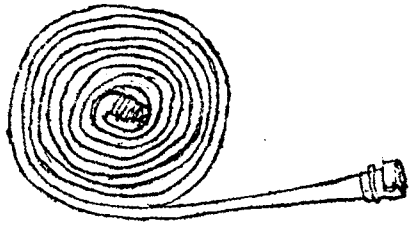
Each rescueman shall use his discretion in SCUBA operations. Where a team could proceed under piers and wharves to extinguish a fire with safety, they may proceed,but if an unsafe situation exists, the monitor should be manipulated from the outside.

General

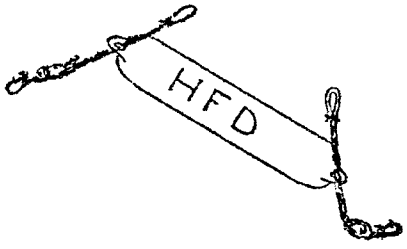
Besides the above-mentioned equipment, the fireboat carries many items which are commonly used in land firefighting and rescue operations. Among these standard items are: breathing apparatus, smoke ejector and syphons. Included among the not so standard but self-explanatory items are the life jackets and life gun.

B. Hose Used

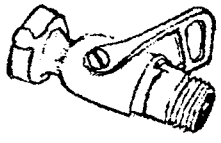
1. 2-1/2 inch hose (Dacron/Cotton)
2. Single lines preferable to each float



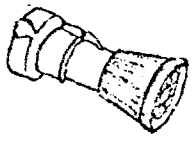
C. Fenders are placed and secured on specified areas on the hose.

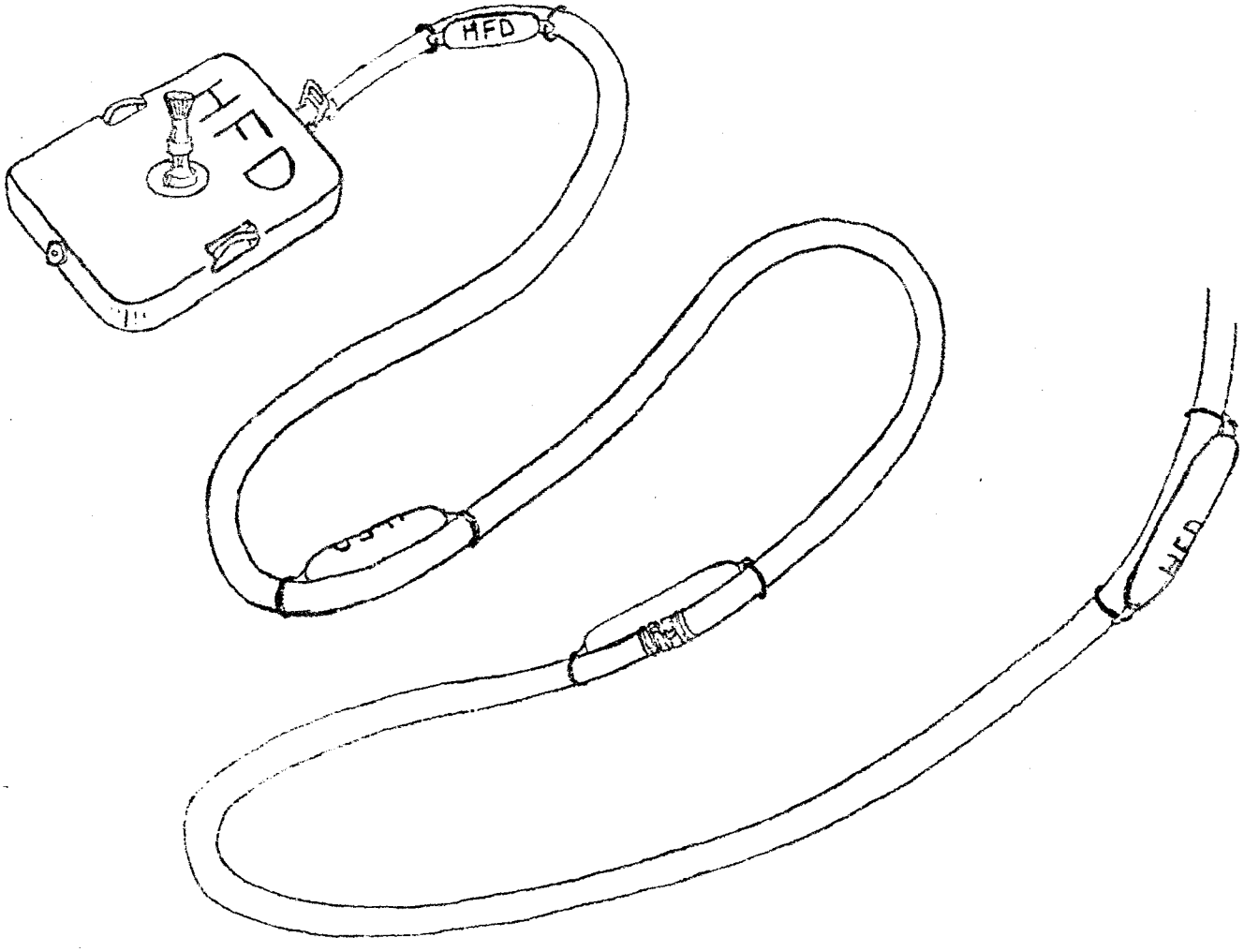


D. Shut-offs (2-1/2 inch) - connected to each float, to the 2-1/2 inch female coupling.



E. Nozzle (2-1/2 inch) - connected to top of 2-1/2 inch male fitting on float (outlet)

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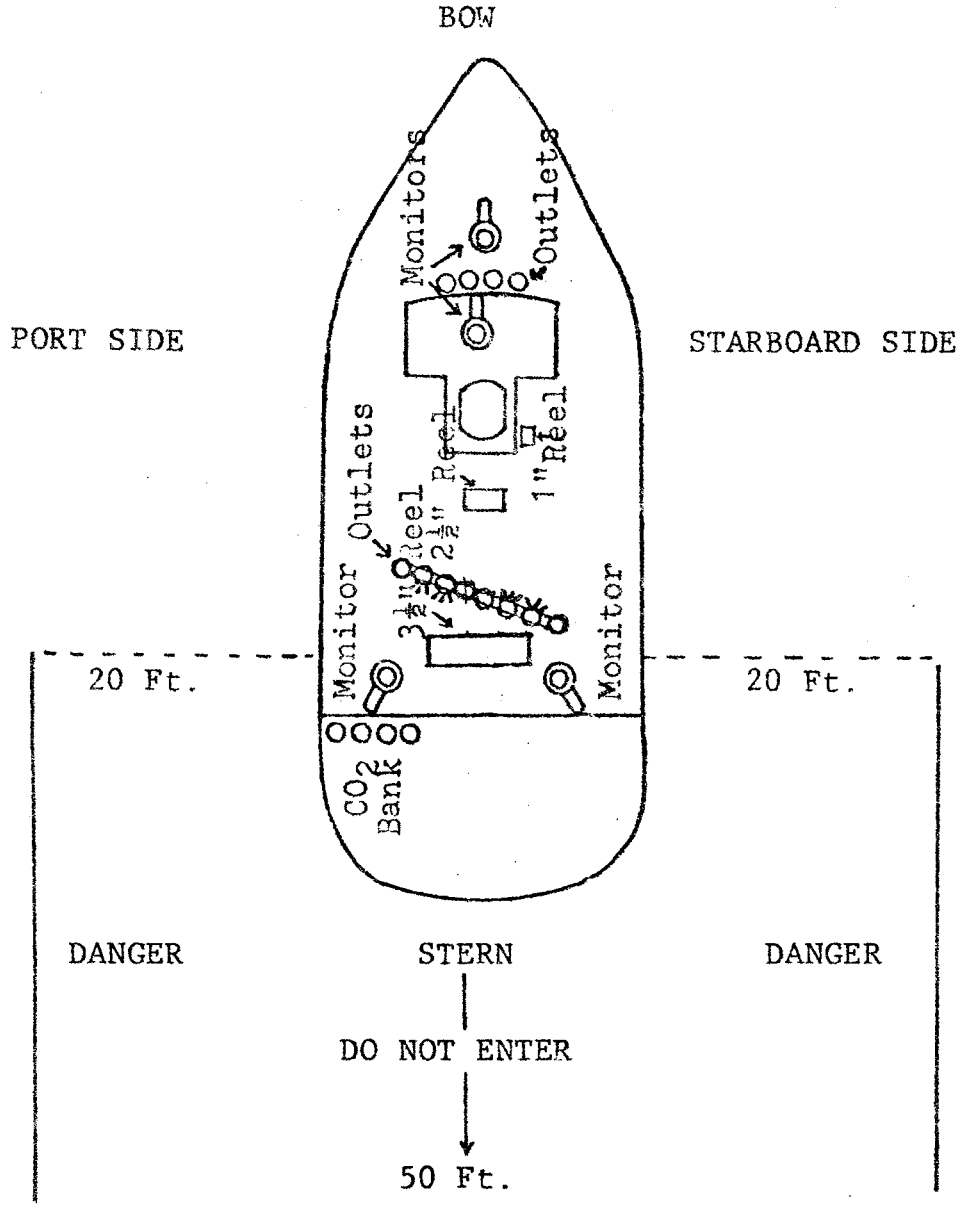
APPROACH TO AND DEPARTURE FROM FIREBOAT



Back-wash will be great for men approaching from this direction if vessel is running forward. DO NOT approach from this direction if vessel is running astern.

FIREBOAT
"ABNER T. LONGLEY"

BUILT BY	Albina Engine and Machine Works, Portland, Oregon - 1951
COMMISSIONED	October 1, 1951
NAMED AFTER	An engineer with the Honolulu Harbor Board
COST	$215,293.30
DESIGNER	Thomas D. Bowes, M.E., Phil., PA.
GROSS TONNAGE	130 Tons
NET TONNAGE	60 Tons
LENGTH	87 Ft. L.O.A. 82 ft. L.B.P. (Bottom Plate)
BEAM	19 ft. 19 in.
DEPTH	11 ft. 2 in.
DRAFT: FORWARD	4 ft. 3 in.
AFT	7 ft. 5 in.
MEAN	5 ft. 10 in.
HORSEPOWER	660 at 1880 RPM-4 to 1 reduction gear
PROPELLER	Single screw - four blades
SPEED	13.43 knots or about 15.46 mph
ENGINES	6 GMC Diesel engines-165 HP, 6 cy., 71 ser., 4 for propulsion or pumping, 2 outboards for driving the two stage pumps
FIRE PUMPS	6 rated at 1500 GPM each, total cap. 9000
FUEL	3900 gallons diesel fuel
LIQUID FOAM	1000 gallons-2 tanks, 500 gallons each
LIQUID FOAM MIXED	160,000 gal, which covers about 5 acres

ELECTRIC SYSTEM	2 Buda Diesel Generators, 6KW 14-8 volt storage batteries (storage bank) 4-8 volt storage batteries (starting bank)
CO_2 SYPHONS SYSTEMS	500 lbs. in 5 cylinders, 100 lb. each with 400 ft. of hose
HOSE	3-1/2 inch - 1,000 ft. 2-1/2 inch - 1,000 ft. 1-1/2 inch - 400 ft. 1 inch - 200 ft.
OUTLETS	8-3½ in., 4 of which are gated with 3-2½ in. gated valves 4-2½ in., suitable for either foam or water 4-1 in.
LADDERS	1-7 ft., 1-25 ft.
SCUBA FLOATS	4 firefighting scuba floats
BREATHING APPARATUS	SURVIVAIR - 9 units with 9 spare cylinders
ANCHOR CABLE	500 ft. of 5/8 inc. cable
LIFE JACKETS	12 cork jackets - topside storage 16 cork jackets - below deck storage 18 kapok jackets - below deck storage
LIFE GUN	1 - CO_2 operated with 3 rolls of retrieving line
SMOKE EJECTOR	1 - with 3 non-collapsible ducts (16 in. by 25 ft. each) and 1 collapsible (15 ft.)
MONITORS	5 fixed - 1 on foredeck, 1 above wheelhouse, 1 on tower, 2 on aft deck

MACHINERY

6 - 165 HP Diesel engines
6 - 1500 GPM fire pumps
2 - 6 KW Buda generators and switchboard
1 - 112 volt and switchboard battery system
1 - 32 volt starting battery system
1 - Air compressor and tank system
Fresh water system
1 - Fuel oil transfer pump, bilge pump, foam pump
1 - Electric hydraulic steering system, tower elevating syste,
1 - Anchor windlass
1 - Smoke ejector
4 - Water syphon
1 - 10 ft. work boat with 6 HP motor

HELICOPTER

The Honolulu Fire Department maintains a Bell Helicopter to handle various firefighting and rescue operations. The Department purchased the helicopter in December 1968, and has designated it Air-1 located near the Honolulu International Airport. The helicopter is capable of holding a maximum of 60 gallons of fuel for a flying time of 3 hours. It is essential in emergency situations. From its hangar, the helicopter can fly to Makapuu Point in 15 minutes and to the North Shore in 25 minutes.

The certified HFD helicopter pilot is in complete command of the aircraft and is responsible for providing safe and competent service. The pilot reserves the discretion to determine whether or not the operation in question is safely feasible. The capabilities of the helicopter are to be ascertained by the pilot. When considering conditions, the pilot must weigh the hazard of contributing factors such as inaccessibility of the fire/rescue area and weather conditions.

The helicopter has a maximum external load capacity of 662 pounds and can seat 3 people. The aircraft is equipped with a water tank to aid in the extinguishment of brush fires when accessibility by fire apparatus is especially slow and difficult. The tank is made of an aluminum alloy, roughly weighs 60 pounds, and has a 105 gallon capacity. Two men can quickly attach the portable water tank to the bottom of the helicopter in 10 minutes. The tank fits snugly underneath the cabin and engine. Depending upon the situation, the pilot must decide whether to carry less than 60 gallons of fuel in order to compensate for the additional weight of a full water tank. If a full water tank is not required, the helicopter can afford to carry more gas.

The helicopter carries a stokes basket and billy pugh net unless it is responding to a brush fire. In such fire situations, the basket and billy pugh net are removed to make room for the water tank. A metal box strapped to the stokes basket holds various items including a first aid kit, life preserver, and ropes. The helicopter is also equipped with a PA system, siren, and a 1000-watt night sun light.

The primary function of the helicopter is lifesaving. Some sort of emergency requiring the assistance of the aircraft occurs everyday. While mountain rescues are spectabular, it is the ocean rescue providing no steady and reliable landmark which truly tests the skills of the pilot. The more common emergencies are stranded hikers, boats and swimmers in distress, lost people, and brush fires.

Although it yet has not been called to do so, the helicopter is also capable of rescuing people off a highrise. A billy pugh net would be lowered if the helicopter is prevented from landing on the roof of the building.

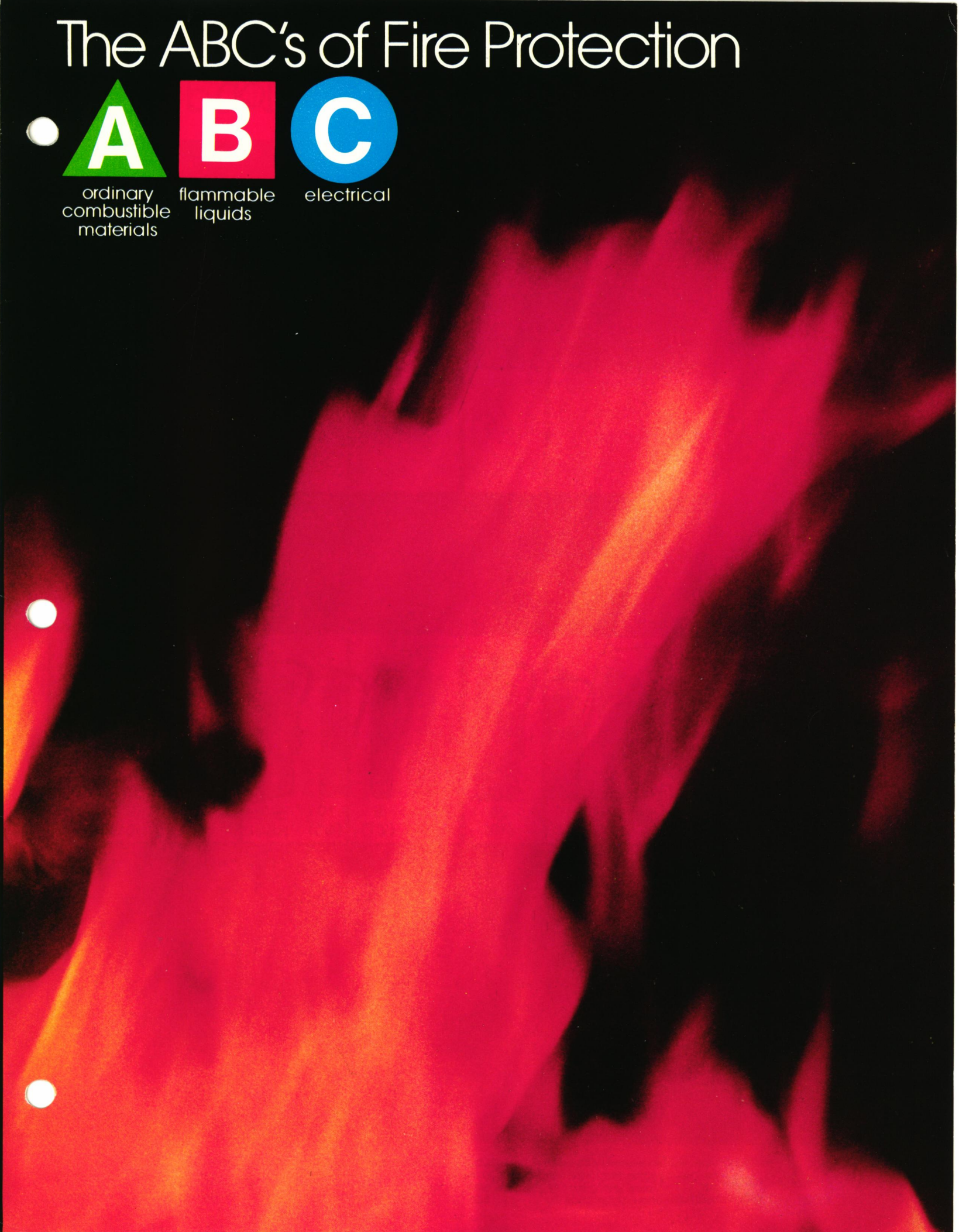
With approval from the City Managing Director's Office, the helicopter performs a number of non-emergency operations. The helicopter routinely carries city officials, visiting dignitaries, and fire officials. Many agencies have been aided by the helicopter. The aircraft enables, among others, the Board of Water Supply to survey the watersheds, the Department of Parks and Recreation to view its areas, and the City Planning Department to determine the feasibility of different projects.

The ABC's of Fire Protection

A ordinary combustible materials

B flammable liquids

C electrical



The ABC's of fire protection

How to choose the right Kidde extinguisher for three basic classes of fire.

Type of Agent	Tri-Class (ABC) Dry Chemical Monoammonium Phosphate	Regular Dry Chemical Sodium Bicarbonate	Halon 1211 Bromochlorodifluromethane	Carbon Dioxide	Water	Tri-Class (ABC) Dry Chemical Monoammonium Phosphate	Regular Dry Chemical Sodium Bicarbonate	Carbon Dioxide
Fires in ordinary combustible materials—paper, wood, fabrics, rubber and many plastics. Quenching by water or insulating by Tri-Class (ABC) dry chemical is effective.	yes excellent Adheres to burning materials and forms a coating which will smother the fire and minimize reflash.	not recommended	not rated. However, may be effective on very small CLASS A Fires.	not recommended	yes excellent Water saturates material and prevents rekindling.	yes excellent Adheres to burning materials and forms a coating which will smother the fire and minimize reflash.	not recommended	not recommended
Fires in flammable liquids—gasoline, oils, greases, tars, paints, lacquers and flammable gases. Tri-Class (ABC) and Regular Dry Chemical, Halon 1211 and Carbon Dioxide agents smother these fires.	yes excellent Dry chemical agent smothers fire. Screen of agent shields user from heat.	yes excellent Dry chemical agent smothers fire. Screen of agent shields user from heat.	yes excellent Halon 1211 leaves no residue, will not normally affect equipment.	yes excellent Carbon dioxide leaves no residue, may not affect or damage equipment.	no Water will spread flammable liquids, not put it out.	yes excellent Dry chemical agent smothers fire. Screen of agent shields user from heat.	yes excellent Dry chemical agent smothers fire. Screen of agent shields user from heat.	yes excellent Carbon dioxide leaves no residue, may not affect equipment or foodstuff.
Fires in live electrical equipment—motors, generators, switches and appliances—where a non-conducting extinguishing agent Tri-Class (ABC) and Regular Dry Chemical, Halon 1211 and Carbon Dioxide is required.	yes excellent Dry chemical agent is non-conductive. Screen of agent shields user from heat.	yes excellent Dry chemical agent is non-conductive. Screen of agent shields users from heat.	yes excellent Halon 1211 is a non-conductor, leaves no residue, will not normally affect or damage electrical equipment.	yes excellent Carbon dioxide is non-conductive, leaves no residue, may not affect or damage electrical equipment.	no Water, a conductor, should never be used on live electrical fires.	yes excellent Dry chemical agent is non-conductive. Screen of agent shields user from heat.	yes excellent Dry chemical agent is non-conductive. Screen of agent shields user from heat.	yes excellent Carbon dioxide is non-conductive, leaves no residue, may not affect or damage electrical equipment.
Each class of fire calls for the right kind of extinguisher. Using the wrong extinguisher is dangerous and may do more harm than good. For your own protection, you should know the classes of fire, the different types of extinguishers, how to use them and why.	 2½ lbs. (1.1)Kg. 6 (2.7) 10 (4.5) 20 (10)	 2¾ lbs. (1.2)Kg. 6 (2.7) 10 (4.5) 20 (10)	 2½ lbs. (1.1)Kg. 5 (2.3)	 5 lbs. (2.3)Kg. 10 (4.5) 15 (6.8) 20 (9)	 2½ gals. (9.5 liters)	 150 lbs. (67.5)Kg.	 150 lbs. (67.5)Kg.	 50 lbs. (22.5)Kg.
Model Number	1A10B:C* | 2A40B:C | 10TAS | 20TAS	10B:C* | 40B:C | 10RAS | 20RAS	2½BCF | 5BCF	5KS-3 | 10KS-3 | 15KS-3 | 20KS-4	2½ WLS-A	150 ABCR	150DCPR	50HR
Content (net weight of agent) lbs. (kg.)	2½ (1.1) | 6 (2.7) | 10 (4.5) | 18 (8.2)	2¾ (1.2) | 6 (2.7) | 10 (4.5) | 20 (10)	2½ (1.1) | 5 (2.3)	5 (2.3) | 10 (4.5) | 15 (6.8) | 20 (9)	2½ gals. (9.5 liters)	150 (67.5)	150 (67.5)	50 (22.5)
UL Rating	1A10B:C | 2A40B:C | 4A60B:C | 10A80B:C	10B:C | 40B:C | 60B:C | 80B:C	5B:C | 10B:C	5B:C | 10B:C | 10B:C | 10B:C	2A	40A,160B:C	160B:C	20-B:C
**Listings, Approvals, Standards Requirements met or exceeded	UL OSHA, USCG* BMC* DOT MTI | UL FM, OSHA, USCG* BMC* DOT MTI | UL FM, OSHA USCG* DOT MTI | UL FM, OSHA, USCG* DOT MTI	UL OSHA USCG* BMC* DOT MTI | UL FM OSHA USCG* BMC* DOT MTI | UL FM OSHA USCG* DOT MTI | UL FM OSHA USCG* DOT MTI	UL USCG* DOT | UL USCG* DOT	UL FM, OSHA USCG* DOT CBSI | UL FM, OSHA, USCG* DOT CBSI | UL FM OSHA USCG* DOT CBSI | UL FM OSHA DOT	UL FM OSHA	UL FM OSHA DOT MTI	UL FM OSHA DOT MTI	UL OSHA DOT MTI

UL — **Underwriters' Laboratories, Inc.
FM — Factory Mutual Research Corp.
MTI — Marine Testing Institute
USCG — United States Coast Guard
CBSI — Canadian Board of Steamship Inspection
OSHA — Occupational Safety and Health Act
BMC — Bureau of Motor Carrier Safety Reg.; Par. 393.95
DOT — U.S. Department of Transportation

*USCG and BMC approval only when used with strap type mounting bracket.
Model 10-B:C supplied with plastic strap bracket.
Model 1-A,10-B:C supplied with metal strap bracket.

Additional charts may be obtained from Kidde Regional Offices or your local Kidde Distributor.

CLASS D FIRES

This specialized classification includes fires in combustible metals such as magnesium, titanium, zirconium, sodium potassium and others. A special extinguishing powder, Kidde MetalGuard, may be applied by scoop or shovel.

OPERATION

Each Kidde extinguisher is considered professional equipment and its effectiveness in protecting your property depends on knowing what it CAN and CANNOT DO, how to use it, where to install it and how to maintain it. You should know the classes or types of fires which may be encountered, what class or classes of fire the extinguisher is capable of extinguishing and be prepared to use it properly and effectively.

Kidde extinguishers are supplied with an Owners Manual which contains operating instructions. Study this manual carefully. In addition, each extinguisher label contains operating instructions which must be studied and followed to ensure proper operation.

MAINTENANCE

Each extinguisher requires proper maintenance for initial and continued operation. All extinguishers are to be maintained and serviced in accordance with Kidde Operation and Maintenance Instructions, National Fire Protection Association Standard No. 10 and Compressed Gas Association pamphlets C-1, C-6 and P-1.

NFPA-10

The National Fire Protection Association Standard for Portable Fire Extinguishers (NFPA-10) is considered part of Kidde Operation and Maintenance Instructions. NFPA-10 Standard provisions apply to the selection, installation, inspection, maintenance and testing of portable fire extinguishing equipment. NFPA-10 may be purchased from the National Fire Protection Association, 470 Atlantic Avenue, Boston, Massachusetts 02210.

C. G. A.

Compressed Gas Association (C. G. A.) pamphlets C-1, C-6 and P-1 are also considered part of Kidde Operation and Maintenance Instructions. The C. G. A. recommendations apply to hydrostatic testing, visual inspection and handling of compressed gas containers. C. G. A. pamphlets can be obtained from the Compressed Gas Association, 500 5th Avenue, New York, 10036

Kidde extinguishers are sold and serviced by Fire Equipment Distributors throughout the world. Refer to Yellow Pages under "Fire Extinguishers".

Kidde Belleville has produced "In Case of Fire", an instructional color-sound film (16mm or cassette) on portable extinguishers. This film may be obtained through Kidde Fire Equipment Distributors.

REGIONAL SALES OFFICES/WAREHOUSES
California 90806, Signal Hill
Georgia 30341, Atlanta
Illinois 60525, LaGrange
New Jersey 07109, Dept. T, Belleville

CANADIAN OFFICES
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Germany, Luneburg: Walter Kidde G.m.b.H.
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Sweden, Kungalv: Svenska Skumslackings AB

KIDDE BELLEVILLE

Division of Kidde, Inc.
Belleville, New Jersey 07109

P-117-R15-5/80 PRINTED IN U.S.A.

PORTABLE FIRE EXTINGUISHERS

GENERAL INFORMATION

Fire is divided into four basic types and assigned a letter to designate each type or classification. The classifications are as follows:

Class A - Involves ordinary combustibles such as wood paper, rubber and many plastics.

Class B - Involves flammable liquids, gases and greases.

Class C - Involves energized electrical equipment where the electrical non-conductivity of the extinguishant is highly important. (When the electrical is de-energized, the fire becomes Class A or B)

Class D - Involves combustible metals such as magnesium, sodium, potassium, titanium, lithium, zirconium, etc.

Portable fire extinguishers are classified according to their capability in handling a particular class of fire. All portable extinguishers also display a numerical rating which indicates the relative extinguishing effectiveness of the extinguisher on a designated class of fire.

The rating system is based on physical tests conducted by the Underwriters Laboratories, Inc. and Underwriters Laboratories of Canada and designed to determine the extinguishing ability of each size and type of extinguisher.

These classifications and ratings will consist of a LETTER, NUMERAL and LETTER or a combination thereof and will appear on a label affixed to the extinguisher. The LETTER refers to the class of fire on which the use of the particular extinguishing agent is most effective. The NUMERAL indicates the relative effectiveness of the extinguisher. Multiple letters or numeral-letter ratings are used on extinguishers which are effective on more than one class of fire.

CLASS A RATINGS

Extinguishers for use on Class A fires are classified with the following ratings:

1A, 2-A, 3-A, 4-A, 6-A, 10-A, 20-A, 30-A and 40-A. The NUMERAL is indicative of the relative fire extinguishing potential

of various sizes of the different types extinguishers suitable for use on Class A fires. For example, a 4-A extinguisher can be expected to extinguish approximately twice as much fire as a 2-A extinguisher.

CLASS B RATINGS

Extinguishers for use on Class B fires are classified with the following ratings:

1-B, 2-B, 5-B, 10-B, 30-B, 40-B...ranging up to 640-B. The NUMERAL serves two purposes:

a. It is indicative of the relative fire extinguishing potential of various sizes of the different types of extinguishers suitable for Class B fires.

b. It is also an approximate indication of the square-foot area of a deep-layer flammable liquid fire which an average operator can extinguish.

For example, a 10-B unit can be expected to extinguish ten times as much fire as a 1-B unit and should successfully extinguish 10 square feet of a flammable liquid fire when used by a trained operator.

CLASS C RATINGS

No NUMERAL is used since Class C fires are essentially either Class A or B fires involving energized electrical wiring and equipment. The size of the different suitable extinguishers installed should be commensurate with the size and extent of the area involving the electrical hazard or containing equipment being protected.

Example 1 - Dry Chemical Extinguisher, rated 5-B, C. This extinguisher should extinguish approximately five times as much Class B fire as a 1-B unit and should successfully extinguish a flammable liquid fire of 5 square feet area when used by a trained operator. It is also safe to use on fires involving energized electrical equipment.

Example 2 - Multi-purpose Extinguisher, rated 4-A, 20-B, C. This extinguisher should extinguish approximately four times as much Class A fire as a 1-A extinguisher, 20 times as much Class B fire as a 1-B extinguisher, and a flammable liquid fire of a 20 square feet area when used by a trained operator. It is also safe to use on fires involving energized electrical equipment.

CLASS B RATINGS

Extinguishers for use on Class B fires are classified with the following ratings:

1-B, 2-B, 5-B, 10-B, 30-B, 40-B...ranging up to 640-B. The NUMERAL serves two purposes:

a. It is indicative of the relative fire extinguishing potential of various sizes of the different types of extinguishers suitable for Class B fires.

b. It is also an approximate indication of the square-foot area of deep-layer flammable liquid fire which an average operator can extinguish.

For example, a 10-B unit can be expected to extinguish ten times as much fire as a 1-B unit and should successfully extinguish 10 square feet of a flammable liquid fire when used by a trained operator.

CLASS C RATINGS

No NUMERAL is used since Class C fires are essentially either Class A or B fires involving energized electrical wiring and equipment. The size of the different suitable extinguishers installed should be commensurate with the size and extent of the area involving the electrical hazard or containing equipment being protected.

Example 1 - Dry Chemical Extinguisher, rated 5-B, C. This extinguisher should extinguish approximately five times as much Class B fire as a 1-B unit and should successfully extinguish a flammable liquid fire of 5 square feet area when used by a trained operator. It is also safe to use on fires involving energized electrical equipment.

Example 2 - Multi-purpose Extinguisher, rated 4-A, 20-B, C. This extinguisher should extinguish approximately four times as much Class A fire as a 1-A extinguisher, 20 times as much Class B fire as a 1-B extinguisher, and a flammable liquid fire of a 20 square feet area when used by a trained operator. It is also safe to use on fires involving energized electrical equipment.

CLASS D RATINGS

No NUMERAL is used since there are so many metals which would require extremely different ratings. The relative effectiveness of those extinguishers for use on specific

combustible metal fires is detailed on the extinguisher faceplate.

All modern fire departments equip their apparatus with portable fire extinguishers. In fact, the NFPA recommends that each apparatus carry at least two approved portable fire extinguishers,the variety of which shall be suitable for use on Classes A, B and C fires. Successful use of these extinguishers depends upon:

1. Proper choice of extinguisher and extinguishant for the class of fire encountered.

2. Knowing that there is sufficient extinguishant for the size of fire to be put out.

3. Knowledge of how to operate the extinguisher mechanically and the proper techniques for applying the extinguishant.

4. Ensuring the proper functioning of the extinguisher through established programs of inspection and maintenance.

METHODS OF EXPELLING EXTINGUISHANT

There are six common methods of expelling or applying extinguishing agents:

1. Hand Propelled - The material is applied with a scoop, pail or bucket.

2. Mechanically Pumped - Operator provides the expelling energy by means of a pump. The tank or vessel containing the extinguishant is not pressurized. An example is the pump tank.

3. Stored Pressure - The extinguishant and the expellant gas are contained in the same vessel. Examples are: loaded stream and dry chemical.

4. Gas Cartridge - Expellant gas is confined in a separate pressure vessel until operator releases it to the shell containing the extinguishant which is then forced out through the hose. Examples: loaded stream, dry chemical and dry powder.

5. Self Expelling - This extinguishant has sufficient vapor pressure to expel itself. Example: CO_2.

6. Self-Generating - Actuation of the extinguisher causes a chemical (such as sulfuric acid or aluminum sulphate) to mix with the solution in the outer shell resulting in the rapid production of a gas (usually CO_2) which forces the extinguishant out through the hose. Examples: soda-acid and foam.

WHICH EXTINGUISHERS TO USE:

Class A Fires - Foam, loaded stream, multi-purpose dry chemical and water types.

Class B Fires - CO_2, dry chemical (either regular or multi-purpose)

Class C Fires: CO_2 and dry chemical (either regular or multi-purpose)

Class D Fires - Dry powder (not to be confused with dry chemical). The type of dry powder used depends upon the type of metal burning. The below listed Class D extinguishing agents are identified by their trade names.

a. Pyrene G-a Powder - Screened, graphitized foundry coke to which an organic phosphate has been added. UL approved for use only on dry magnesium fires, but has also been found to be effective on sodium, potassium, lithium, titanium, thorium, hafnium, uranium and plutonium. G-1 cannot be discharged from an extinguisher, so it must be applied with a shovel or scoop.

b. Metalguard Powder - Identical to G-1; it is simply another trade name.

c. MET-L-X Powder - Composed of sodium chloride (common table salt) with certain additives to promot flowability, moisture, repellancy and a thermoplastic material which binds it into a solid mass under fire conditions. MET-L-X is applied from an extinguisher which looks and operates like a regular dry chemical extinguisher. UL approved for magnesium, sodium, potassium, zinc, uranium and titanium

d. LITH-X Powder - A graphite based powder suitable for discharge from an extinguisher. It is especially recommended for lithium fires, but is also effective on magnesium, zinc and sodium fires.

While these four types of Class D extinguishants by no means complete the list, they are the ones fire fighters are most likely to encounter. These encounters normally will take place on the premises of a shop or manufacturer using the type of metal for which the particular dry powder is necessary as and extinguishant. Some agents are valuable in working with several metals; others are useful for combating only one type of metal fires. Some of the agents are intended to be applied by means of a hand shovel or scoop, others by means of portable fire extinguishers designed for use with dry powders and some are approved for application by either method. The application of the agent should be of sufficient depth to adequately cover the fire area and provide a smothering blanket. The agent should be applied gently on metal fires to avoid breaking any crust which may have formed over the burning metal. When the crust over the burning metal is broken, the fire usually flares up and exposes more raw material to combustion. Information covering other type of Class D agents may be found in the NFPA Handbook.

NOTE: The products of combustion of some of these metals are toxic. Self-contained breathing equipment is definitely required. In addition, those metals which are radioactive require additional appropriate protective apparel.

OPERATION:

There are four basic steps to the operation of an extinguisher:

1. Selection (according to Class of fire)

2. Transport of extinguisher to scene of fire.

3. Actuation of extinguisher.

4. Application of the extinguishant to the fire.

Selection. Since the class of the fire determines which extinguisher should be used, fire fighters must be able to make the correct selection without hesitation.

While approval agencies require permanent markings on the front of each extinguisher, indicating its purpose, these markings are usually difficult to read due to small type size, lighting conditions, excitement of the situations, etc. Conspicuous markings (usually decals on each fire extinguisher as shown should be easily recognized by fire deparment members

EXTINGUISHERS SUITABLE FOR CLASS "A" FIRES

Triangle is colored green.

ordinary combustibles

EXTINGUISHERS SUITABLE FOR CLASS "B" FIRES

Square is colored red.

flammable liquids

EXTINGUISHERS SUITABLE FOR CLASS "C" FIRES

Circle is colored blue.

electrical

EXTINGUISHERS SUITABLE FOR CLASS "D" FIRES

Star is colored yellow

combustible metals

Transporting. Extinguishers should be so located on the apparatus so that removal is easy and quick. They should be readily accessible without the need for climbing up on the apparatus or removing other equipment. Extinguishers should be carried by their handles, some of which double as a "trigger" or "valve actuator".

Actuation. Once the extinguisher has been transported to the fire, it must be actuated without delay. Firefighters must be familiar with all steps necessary to actuate any extinguisher used by their department. This is where previous training shows its value, since there is no time to read directions.

An extinguisher which is suitable for more than one class of fire may have two or even three of these symbols on its front.

INSPECTION

Inspection is a visual "quick check" to ensure that the extinguisher is available and will operate. Fire Fighter III's should inspect extinguishers daily covering at least the following points:

1. Fully charged with extinguishant.
2. Have not been tampered with.
3. Have sustained no physical damage.
4. Sight gauges, if any, read properly.
5. Locking pins or other safety devices are properly in place.
6. Maintenance Tag is securely attached and up-to-date.
7. Brackets or other retaining devices which secure extinguishers are in good order.
8. Check nozzles to be sure they are not clogged with mud from insects or with foreign matter.

MAINTENANCE

Maintenance is a "thorough check" of the extinguisher. It includes a thorough examination and any necessary repairs, recharging or replacement. Maintenance normally reveals the need for special testing of the shell or other components. This involves disassembly of the extinguisher, examination of all its parts, cleaning, replacement of defective parts, reassembly, recharging and where appropriate, repressurization. Such a maintenance check may indicate that the shell should be hydrostatically tested or even discarded. When maintenance check is completed, a new tag should be properly dated, initialled and attached to the extinguisher.

Maintenance checks should be performed at least once a year, after each use, or when the need for it becomes obvious during an inspection.

HYDROSTATIC TESTS

Hydrostatic tests are required at regular intervals and even more frequently where inspection or maintenance checks indicate the need. Such tests are made on the shells, cylinders, some cartridges and some hose assemblies. It is not necessary to hydrostatically test extinguisher shells such as pump tanks, back packs,etc., whose contents are at atmospheric pressure.

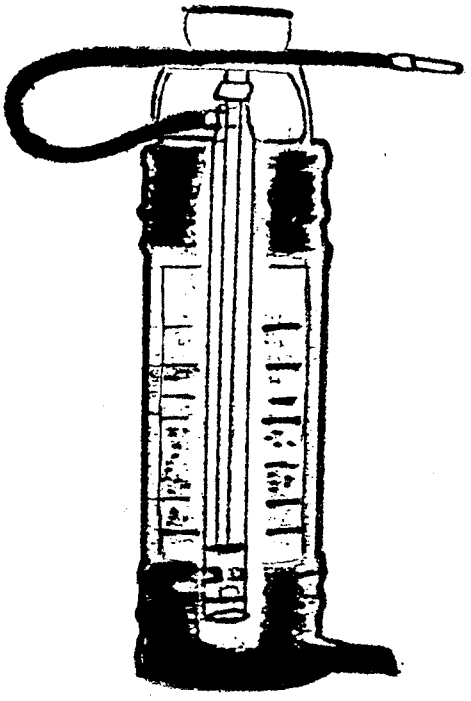
Since hydrostatic testing and maintenance requires personnel with specialized knowledge and training, as well as special equipment and facilities, most fire departments find it preferable to contract with a fire equipment servicing agency for this service.

Hydrostatic Test Interval for Extinguishers

Extinguisher Type	Test Interval (years)
Soda Acid	5
Cartridge operated water and/or antifreeze	5
Stored pressure water and/or antifreeze	5
Wetting Agent	5
Foam	5
Loaded Stream	5
Dry chemical with stainless steel shells or soldered brass shells	5
Carbon Dioxide	5
Dry Chemical, stored pressure, with mild steel shells, brazed brass shells or aluminum shells	12
Dry Chemical, cartridge operated, with mild steel shells	12
Bromotrifluoromethane--Halon 1301	12
Bromochlorodifluoromethane-- Halon 1211	12
Dry Powder, cartridge operated with mild steel shells*	12

*except for stainless steel and steel used for compressed gas cylinders, all other steel shells are defined as "mild steel" shells.

(FIRE PROTECTION HANDBOOK-14th edition, NFPA) 1976



PUMP TANK EXTINGUISHER, 2-1/2 Gallons

The pump tank extinguisher is the simplest water-based extinguisher. It is a cylindrical metal container with a carrying handle on top. It has a built-in hand-operated, vertical piston pump to which a short rubber hose and nozzle has been attached. At the fire, the operator places the extinguisher on the floor or the ground. With one foot at the foothold at its base to steady the unit, move the pump handle up and down to expel the water through hose.

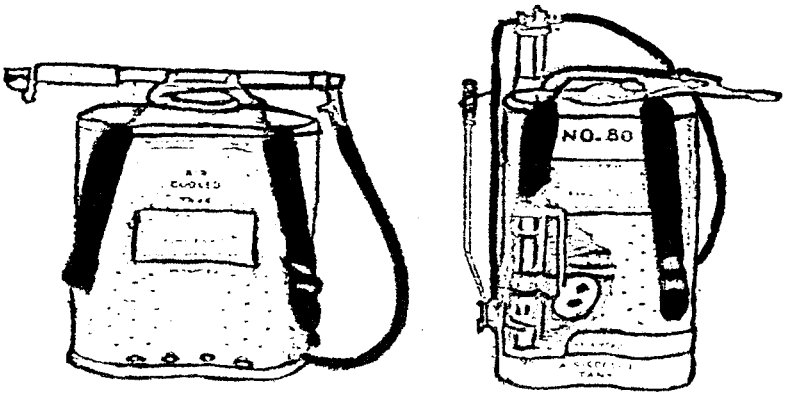
The various back-pack type pump cans operate similarly but with a 5-gallon capacity. Discharge time is usually longer.

Short continuous strokes may provide a better stream than long strokes. The filler cap is provided with a tiny vent which must be kept open so that air may replace the water as it is discharged from the tank.

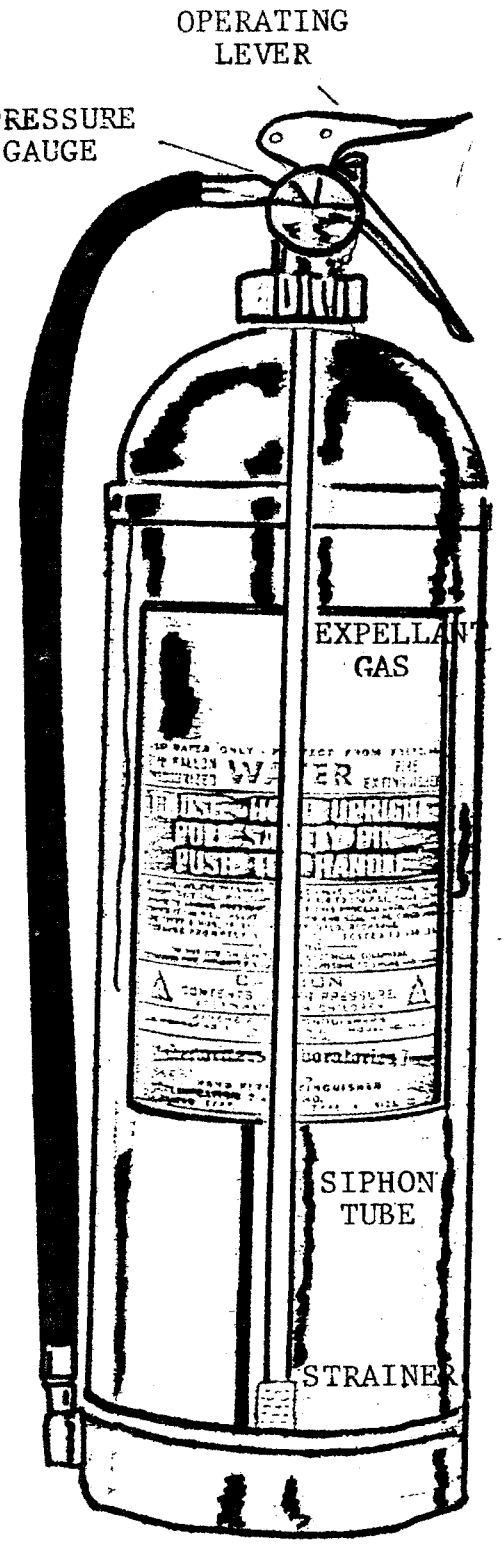
Horizontal range: 30 to 40 feet

Continuous discharge time: about 60 seconds

Primary use: Class A fires.



BACK-PACK PUMP TANKS



STORED PRESSURE EXTINGUISHER
2-1/2 Gallons

The stored pressure extinguisher has a small pressure gauge and a squeeze-type carrying and discharge handle. Average air pressure is 100 psi. The air pressure is contained within the extinguisher shell by a valve attached to a syphon tube. The valve is opened by squeezing the handle grip. This allows the stored aire to expel the water through the hose and nozzle. The squeeze grip is rendered inoperative (for carrying purposes) by means of a pin inserted through it. This pin must be pulled out before the extinguisher can be operated. Direct the stream at the base of the fire.

Note:

The loaded stream extinguisher is similar to the stored pressure extinguisher except that an alkali metal salt, usually a potassium salt, is added to the water. This solution causes the flame to go out rather suddenly and has a pronounced fire retardant effect.

Horizontal Range: 30 to 40 feet

Continuous discharge time:
Approximately 60 seconds

Primary uses:

Stored pressure: Class A fires

Loaded Stream: Class A & B fires

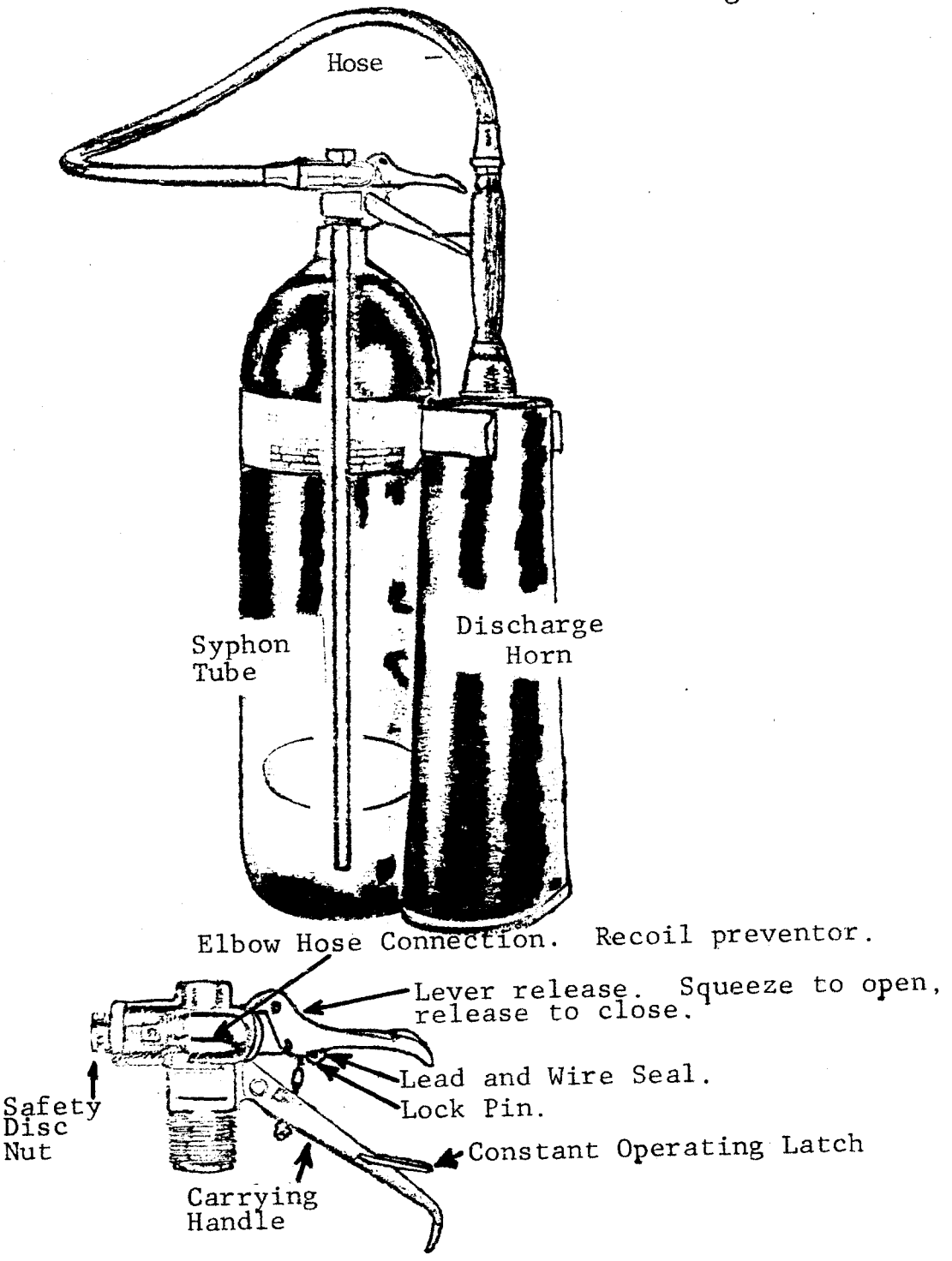
CARBON DIOXIDE EXTINGUISHER

Carbon Dioxide or CO_2 is the most commonly utilized liquified gas extinguisher. The CO_2 is retained in a liquid condition in the extinguisher under a pressure of 800 to 900 psi at normal temperature (70°F). The extinguisher consists basically of a pressure cylinder, a valve and a hose equipped with an applicator.

Operation is achieved by turning a valve or by pulling a pin and squeezing a hand grip. A syphon tube extends to almost the bottom of the cylinder so that 80% of the contents reach the discharge horn as a liquid where it instantly changes to a gas. Expansion ratio of the liquid is approximately 450 to 1; i.e., 1 cubic inch of liquid expands to about 450 cubic inches of gas. The remaining 20% of the contents reach the discharge as a gas. The discharge expels a cloud of carbon dioxide (CO_2) gas with some "snow" through the nozzle horn. CAUTION: DO NOT HANDLE THE "SNOW" AS FROSTBITE MAY OCCUR. The discharge horn should be pointed at the base of the fire. The discharge should be applied to the burned surface even after the flames are extinguished. The deposit of carbon dioxide snow coats the hot surface and any glowing material present and tends to prevent possible reflash of the fire. On flammable liquid and electrical fires, best results are obtained when the discharge from the extinguisher is employed to sweep the flame off the burning surface, applying the discharge first at the near edge of the fire and gradually progressing forward, moving the discharge cone very slowly from side to side. In using extinguishers of this type, especially in unventilated places such as small rooms, closets or confined spaces, operators and others shall take precaution to avoid the effects which may be caused by breathing the vapors in gases liberated or produced. The hazard is the exclusion of oxygen.

Occasionally, operators using Carbon Dioxide extinguishers may experience a shock even though they are not in contact with live electrical equipment. These shocks come from a buildup of static electricity when the extinguisher is being discharged and are generally more of an annoyance than a hazard. However, hydrogen-air and acetylene-air mixtures may be ignited by a spark energy of as little as 0.017 millijoule (NFPA FPH, 14th ed., pp. 5-37 and 16-12). Sweeping the nozzle back and forth across the fire will help lessen the possibility of a static charge.

Horizontal range: 3 to 8 feet
Continuous discharge time: 8 to 30 seconds
Primary use: Class B fires
Class C fires, if the horn is non-metallic



CARBON DIOXIDE EXTINGUISHER

DRY CHEMICAL EXTINGUISHER

There are two types of dry chemical extinguishers. One is the cartridge operated type in which the expellant gas (CO_2 or Nitrogen) is contained in a small cartridge until it is released into the extinguisher shell by puncturing the seal in the cartridge. The expellant gas forces the dry chemical through the hose and out the nozzle valve.

The other type is the stored pressure type in which the expellant gas and dry chemical are stored together within the extinguisher shell.

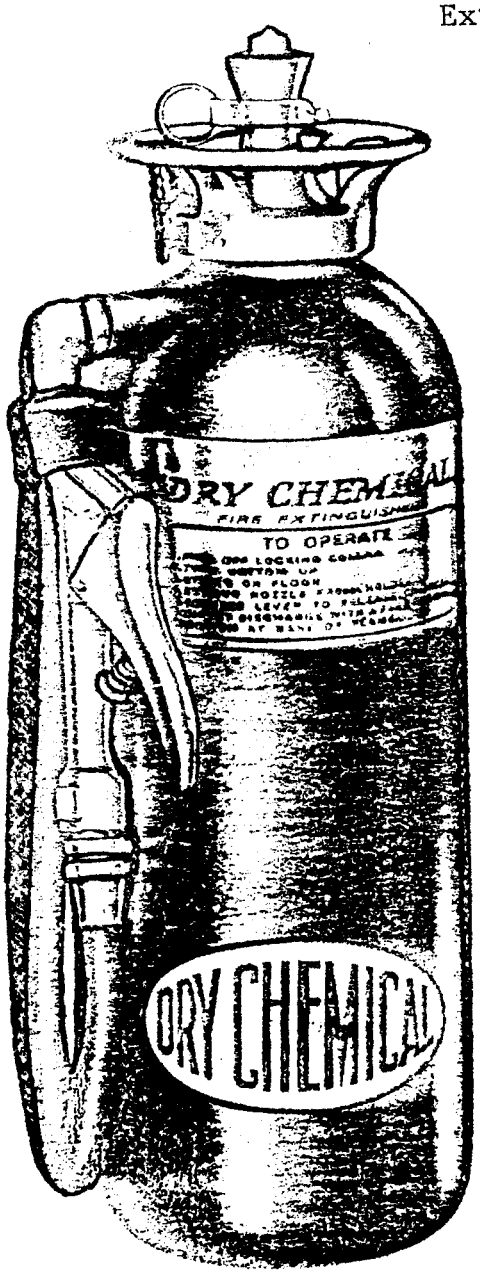
The chemical compound in dry chemical extinguishers consists primarily of Sodium Bicarbonate, Potassium Bicarbonate, Ammonium Phosphate, Urea-potassium Bicarbonate or Potassium Chloride which has been chemically processed to make it moisture resistant and free-flowing. This compound is discharged under pressure and directed at the fire.

On flammable liquid fires, the discharge should be directed at the base of the flames. Best results are obtained by attacking the near edge of the fire and progressing forward moving the nozzle rapidly with a side to side sweeping motion. Some extinguishers have relatively high velocity nozzles and to prevent splashing when used on depths of flammable liquid, care should be taken to direct the initial discharge from a distance not closer than 6 to 8 feet. On surface fires involving textiles, the discharge should be directed at least 3 to 4 feet above the flame from a distance of 8 to 10 feet. By this procedure, the dry chemical provides a coating on surface areas ahead of flash fires. After this application, the discharge can be directed at the initial fire without the danger of spreading the fire. The discharge should be applied to the burning surface even after the flames are extinguished, to prevent possible reflash by coating the hot surfaces and any glowing materials present. In using extinguishers of this type, consideration should be given to any possible hazard which may be created by reduction in visibility due to the cloud of dry chemical.

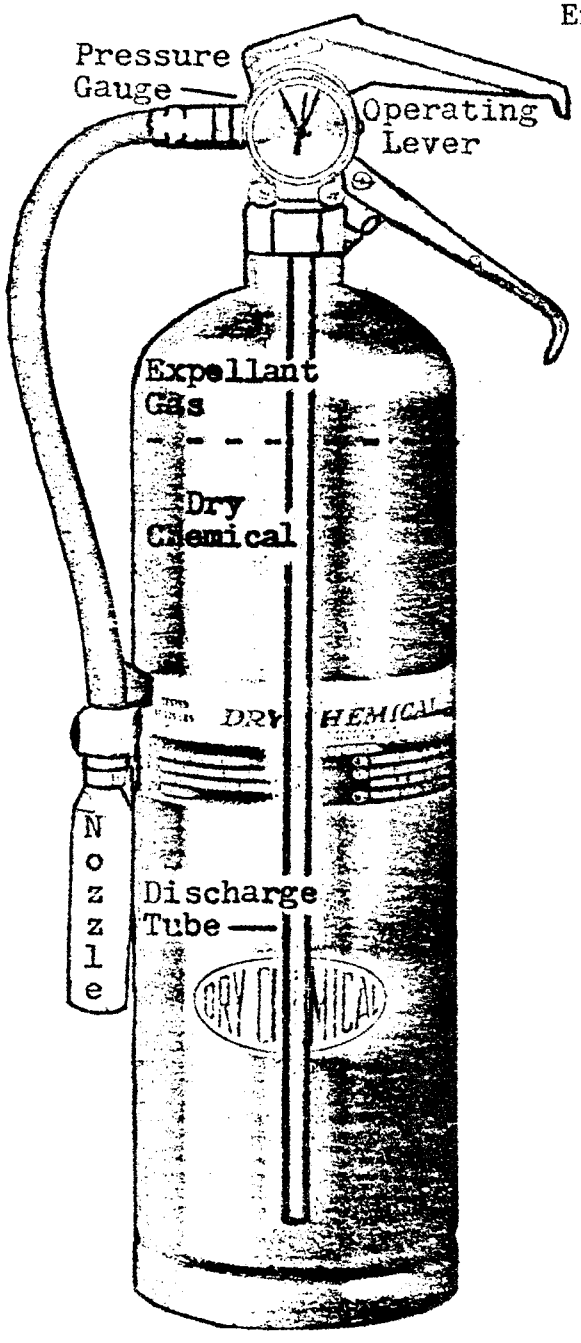
Multipurpose dry chemical (Mono-Ammonium Phosphate and Barium Sulphate) is a mixture of chemicals in powder form found suitable for use on incipient fires in ordinary combustible materials (Class A) as well as on Class B and C fires. They are NOT recommended for use in connection with fires in combustible metals (Class D fires) unless stated on the name-plated. On Class B and C fires, the method of operation is the same as the standard dry chemical units. CARE SHOULD BE TAKEN TO AVOID CONTAMINATION OF ANY TYPE DRY CHEMICAL WITH MULTIPURPOSE TYPE.

On fires in ordinary (Class A) combustibles, the discharge should be directed at the burning surfaces to cover them with chemical. When the flames have been extinguished, the chemical discharge should be intermittently directed on any glowing areas. Careful watch should be maintained for hot spots that may develop and additional agent applied to those surfaces as required to adequately coat them with the extinguishing agent.

Horizontal range: 5 to 20 feet
Continuous discharge time: 10 to 25 seconds
Primary Use:
Regular or Ordinary: Classes B and C fires
Multi-purpose: Classes A, B and C fires



DRY CHEMICAL EXTINGUISHER
Cartridge Operated Type



DRY CHEMICAL EXTINGUISHER
Stored Pressure Type

FOAM EXTINGUISHER

The foam extinguisher has an inner chamber with a loose fitting stopple. This chamber contains an aluminum sulphate solution. The main extinguisher shell holds a bicarbonate of soda solution to which a foam stabilizing agent has been added. When the extinguisher is inverted, the chemical solutions intermix. This produces a liquid foam which expands at a ratio of about 8 to 1, i.e. 2-1/2 gallons of solution produces 18 to 20 gallons of foam. Carbon Dioxide, the expellant gas is evolved from the chemical reaction caused by intermixing the two solutions.

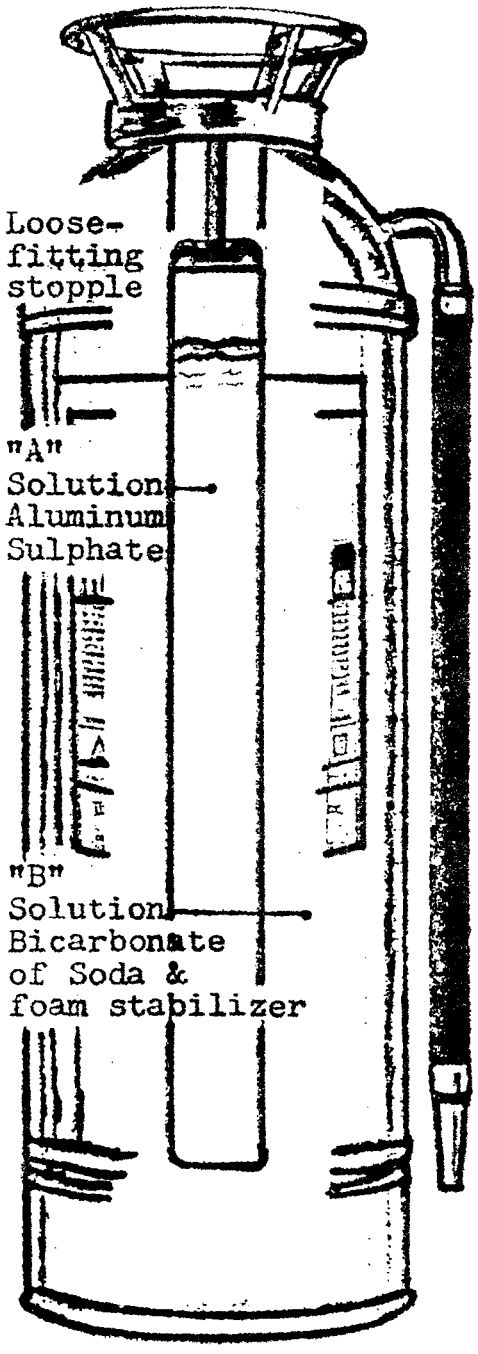
Some foam extinguishers are equipped with an inner chamber of slightly different design. Instead of a loose stopple, a solid diaphragm seals the top of the chamber. A hand wheel on top of the extinguisher must be screwed down. This punctures the diaphragm. Then, when the extinguisher is inverted, the two solutions will intermix.

ONCE THE DISCHARGE PROCESS IS INITIATED, THE ACTION CANNOT BE STOPPED. If, after one or two bumps, the extinguisher still does not activate, the hose is probably plugged.

Move the extinguisher to a safe area and keep all personnel away from it. Pressures built up in the shell may burst the container.

To help alleviate the possibility of a plugged nozzle on small nozzle extinguishers, check to be sure insects have not built their nests inside the small opening of the nozzle.

Horizontal range: 30 to 40 feet
Continuous discharge time: about 90 seconds
Primary use: Class A and B fires



FOAM EXTINGUISHER

AQUEOUS FILM FORMING FORM (AFFF) PORTABLE FIRE EXTINGUISHER

AFFF shows efficiencies of over three times that of protein type foams on open surface gasoline fires. It protects nonignited spills from ignition and secures hazards during rescue operations. It also may be applied to fires simultaneously with other foams, dry chemicals or CO_2.

The two and one half gallon hand extinguisher pressurized to 100 psi discharges in sixty to sixty-five seconds with a horizontal range of approximately thirty feet. When used to combat Class B flammable liquids, AFFF forms a film that floats over the fuel surface, providing a vapor seal that extinguishes flames and prevents reignition.

AFFF hand extinguisher has a small pressure gauge and a squeeze-type carrying and discharge handle. The extinguisher is operated by pulling the ring pin and squeezing the handle grip. This allows the stored air to expel the AFFF through the hose and nozzle.

AFFF extinguishers can be identified by the trade mark "LIGHT WATER" (3M Co.) on the face plate.

General Information:

Type listing:	AFFF Hand Fire Extinguisher
U.L. Rating:	2-A: 20-B
Height:	24 inches
Weight:	Charged - 28 lbs.
	Emptied - 7 lbs.

The highly effection of this agent stems from its ability to make water float on fuels which are lighter than water. As the extinguisher is discharged and the agent covers the fuel, an aqueous film floats over the fuel surface and provides a vapor seal. This vapor seal rapidly extinguishes flames and prevents ignition of most Class B hazards.

Special properties of AFFF also provide excellent extinguishment of Class A fires. Remarkable wetting and penetrating properties, resulting from the agent's low surface tension, allow for faster extinguishment than with plain water.

Operation of Hand Extinguisher:

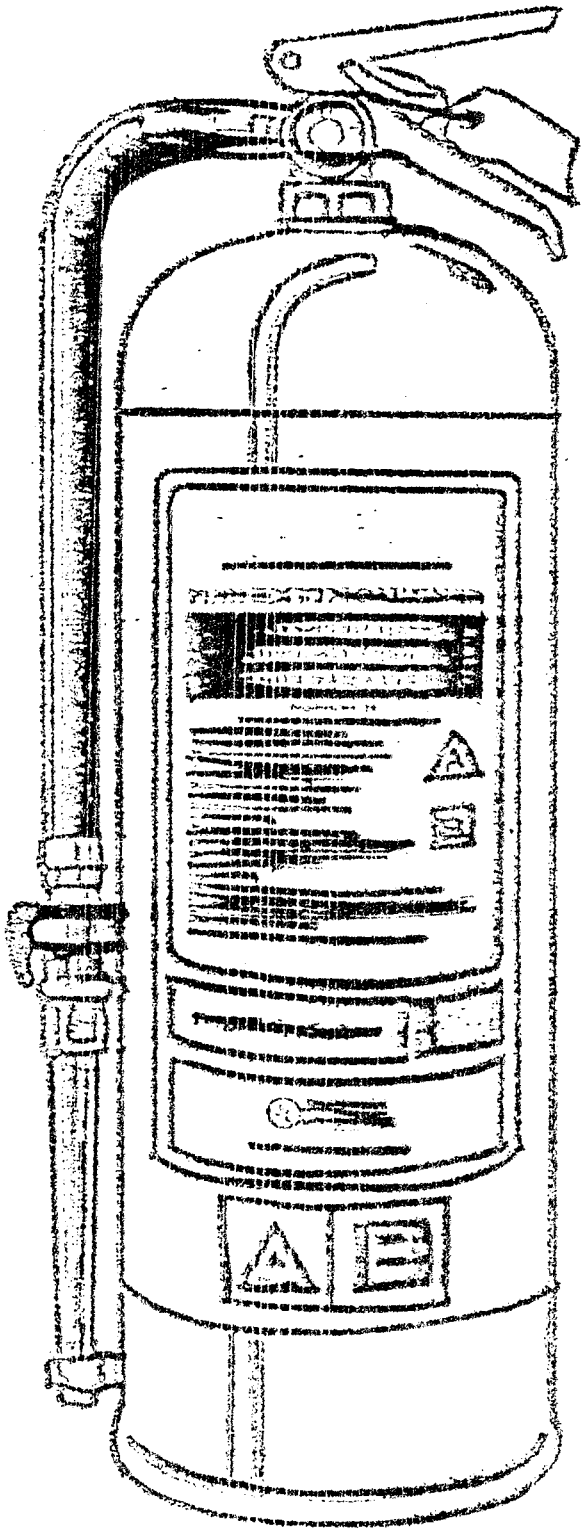
Class A, Class B, Combination A and B Fires:

1. Prepare to operate extinguisher and hold firmly.
2. Do not approach fire closer than necessary. Initial range of extinguisher is approximately 30 feet.
3. Use side-to-side sweeping motions across entire width of the fire.

4. Avoid splashing liquid fuels with discharge stream.
5. After control of fire, move progressively closer to reach far burning sections.
6. After extinguishment, continue application until all surfaces are cooled.
7. Clean-up should begin immediately after fire is extinguished.
8. Watch area carefully until clean-up is complete to be certain there is no reignition.
9. Flush entire burn area with water after clean-up is complete.

Class B Spills, Nonignited Flammable Liquid Hazards:

1. Prepare to operate extinguisher and hold firmly.
2. Do not approach spill closer than necessary. Initial range is approximately 30 feet.
3. Do not come in personal contact with fuel.
4. Cover entire fuel surface using side-to-side sweeping motions.
5. Avoid splashing fuel with discharge stream.
6. Clean-up should begin immediately after spill is completely covered.
7. Watch area carefully until clean-up is complete.
8. Flush entire spill area with water after clean-up is complete.



AQUEOUS FILM FORMING FOAM (AFFF) PORTABLE FIRE EXTINGUISHER

HOSE LAYS AND FITTINGS

The Honolulu Fire Department employs two (2) basic hose layouts -- the straight hose layout and the reverse hose layout. Other hose layouts are variations of the two basic layouts. The straight hose layout means that the fire hoses are laid out from the hydrant or other source of water to the fire. The reverse hose layout is the opposite.

The objective of the hose layouts is to have suitable means through which water can be transported from one point to another under pressure to develop adequate water streams for the extinguishment of fires. To accomplish the layouts, fittings and adapters must be used; therefore, it is vitally important to know how and when to use them.

There are no hard and fast rules concerning the hose layouts prior to the arrival of a fire company as no two fires are the same. However, once the fire company arrives at the fire, the Company Officer or a Superior Officer will make a decision based on his size up of the fire situation. Once the command is given, all members of that company are committed and expected to perform their assignment in a safe and expeditious manner.

HOSE EVOLUTION

FIRELINE

THERE ARE TWO (2) ACCEPTABLE METHODS USED TO ADVANCE THE FIRELINES:

A. DRAGGING METHOD

1. Place the male coupling on the third fold, pull the stacked folds to waist level, and step off the tailboard (the third fold becomes the shoulder loop).

2. Remove the nozzle from the holder and place on the tailboard.

3. Make a 180 degree turn and simultaneously roll your shoulder into the loop and grasping the male coupling at the same time.

4. Carry the nozzle with your free hand and proceed to the fire. The fireline on the fire side should proceed first.

5. Connect the nozzle and set-up the fireline.

B. CARRYING METHOD

1. Place male coupling on first fold and work backward (or forward) until three loops are stacked, pull the stacked folds to waist level, and step off the tailboard. At this point, we should have the male coupling length stacked onto the second fold and the second onto the third fold.

2. Remove the nozzle from the holder and place on the tailboard.

3. Facing the rear of the apparatus, make a 180 degree turn and simultaneously roll your shoulder under the three folds, grasping all three folds firmly on your shoulder. The position of the front of the stacked hose should be down to about waist level.

4. Carry the nozzle with your free hand and proceed to the fire. The fireline on the fire side should proceed first.

5. Connect the nozzle and set-up the fireline.

NOTE: On all apparatus carrying the four (4) inch hose, the nozzle for the 2-1/2" hose shall be preconnected.

HOSE EVOLUTION

SNUBBING HYDRANT - (SINGLE OR DOUBLE LAY)

FF 3: Comes to a complete stop approximately 10 feet past the hydrant.

FF: Removes the hydrant wye from the apparatus and places it on the left side of the 4-1/2" hydrant discharge approximately 3 feet from the base of the hydrant.

Returns to the tailboard of the apparatus and relay snubbers "GO" signal to the FF 3 using rear buzzer.

Snubber: Takes the male end and one fold of the hose for a single snub.

Takes the male end and one fold of the hose in each hand for a double snub.

Step off the tailboard, proceed to a position approximately 5 feet past the hydrant, and drop the folded part of the hose.

Loop the hose completely around the base of the hydrant, secure the crossover with your foot while holding the coupling(s) in your hand and signal the FF 3 to "GO."

After the slack has been taken up, lay the male end(s) at the base of the 4-1/2" hydrant discharge.

Remove the 4-1/2" hydrant cap, FLUSH the hydrant, connect the hydrant wye, and connect the 2-1/2" supply line(s) to the hydrant wye outlets.

Open hydrant, secure the leaking couplings, don a self contained breathing apparatus and report to your Officer for further orders.

SNUBBING HYDRANT - (4" LINE)

FF 3 Comes to a complete stop approximately 10 feet past the hydrant.

Snubber: Takes hold of the 4" connection and one Fold, steps off the tailboard, proceeds to a position approximately 5 feet past the hydrant and drops the folded part of the hose.

HOSE EVOLUTION

Loop the hose completely around the hydrant, secure the crossover with your foot while holding the coupling in your hand and signal the FF 3 to "GO."

After the slack has been taken up, remove the 4-1/2" cap, flush hydrant, and connect the 4" hose to the hydrant.

Open hydrant, secure the leaking couplings, don a self contained breathing apparatus and report to your Officer for further orders.

SOFT SLEEVE - FRONT HOOKUP (PRECONNECT)

FF 3: Comes to a complete stop before the hydrant and with the Snubbers assistance, positions apparatus for connection.

Prepare for pump operations (transfer transmission from Road to Pump).

Disconnect fireline(s), connect to discharge outlet(s), and charge fireline(s) using tank water.

Snubber: Assist FF 3 in positioning apparatus for soft sleeve hookup.

Remove 4-1/2" hydrant cap, FLUSH hydrant, connect soft sleeve to hydrant.

(For non-preconnect units)

Remove front suction cap, connect soft sleeve.

OPEN hydrant, place saddle support under the soft sleeve to relieve the hose weight and to prevent bursting of hose.

Secure leaking couplings, don a self contained breathing apparatus and report to your Officer for further orders.

SOFT SLEEVE - SIDE HOOKUP

FF 3 Position the 6" Pump intake slightly forward or behind of the 4-1/2" hydrant outlet and with Snubbers assistance position apparatus.

EVOLUTION

Come to a complete stop and prepare for Pump operation.

Disconnect fireline(s), connect to discharge outlet(s), and charge fireline(s), using tank water. (Beware, will lose pump pressure when Snubber opens 6" intake cap.)

Snubber: Assist FF 3 in positioning apparatus for side hookup.

Remove 4-1/2" hydrant cap, FLUSH hydrant, and connect soft sleeve to hydrant outlet.

Remove the 6" pump intake cap and connect the soft sleeve hose.

OPEN hydrant, place saddle support under the soft sleeve to relieve the hose weight and to prevent bursting of hose.

Secure leaking apparatus couplings, don a self contained breathing apparatus and report to your Officer for further orders.

HOSE EVOLUTION

Double Straight - 2 Lines (Single straight-same)

FF 3: Comes to a complete stop approximately 10 feet past the hydrant.

Officer: Directs Snubber to "Snub" hydrant.

Snubber: Utilize snubbing technique and snub hydrant.

FF: Remove the hydrant wye from the apparatus and place it on the left side of the 4-1/2" hydrant discharge approximately 3 feet from the base of the hydrant.

Return to the tailboard of the apparatus and relay Snubbers "GO" signal to the FF 3 using rear buzzer.

FF 3: Proceed to and past fire approximately 25 feet and prepare for Pump Operation. Remove discharge and intake caps and prepare for proper connections.

Officer: Directs operation.

NOTE: For the purpose of simplicity, the firefighters on the tailboard shall be numbered FF 1 and FF 3.

FF 1: Breaks fireside line and using hose dragging or carrying technique, stretches one fireline to the area designated by the Officer-In-Charge.

FF 2: Breaks and connects supply line(s) to intake(s), or give to the FF 3 should he be in position to receive the supply(s). On stretches more than 300 feet, assist FF 1 by "feeding" fireline.

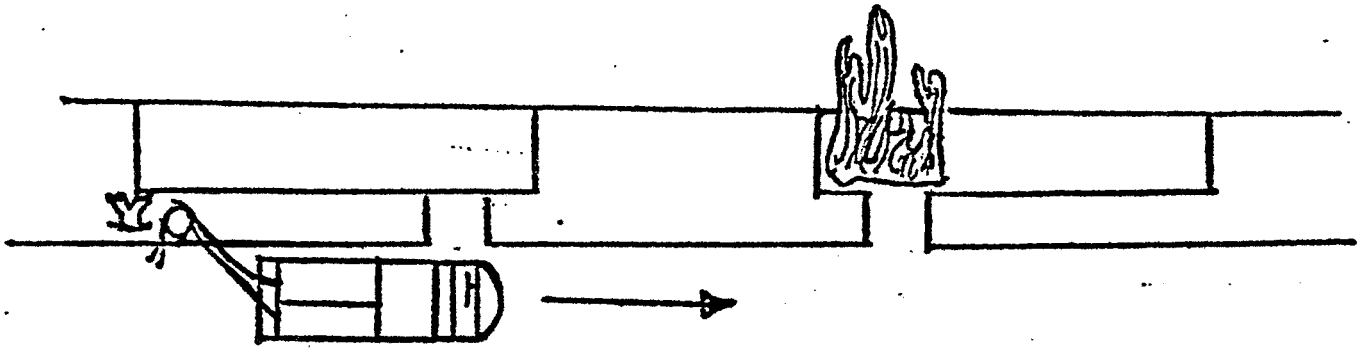
Upon completion, break fireline and connect to outlet or give to FF 3 should he be in position to receive firefighting line. If needed, stretch second fireline to area designated by Officer.

FF 3 (Eng.): Connect supply line(s) to intake(s) and fireline to discharge outlet(s) and charge fireline using tank water until supply lines are charged. If needed, breaks and connects 2nd firefighting lines.

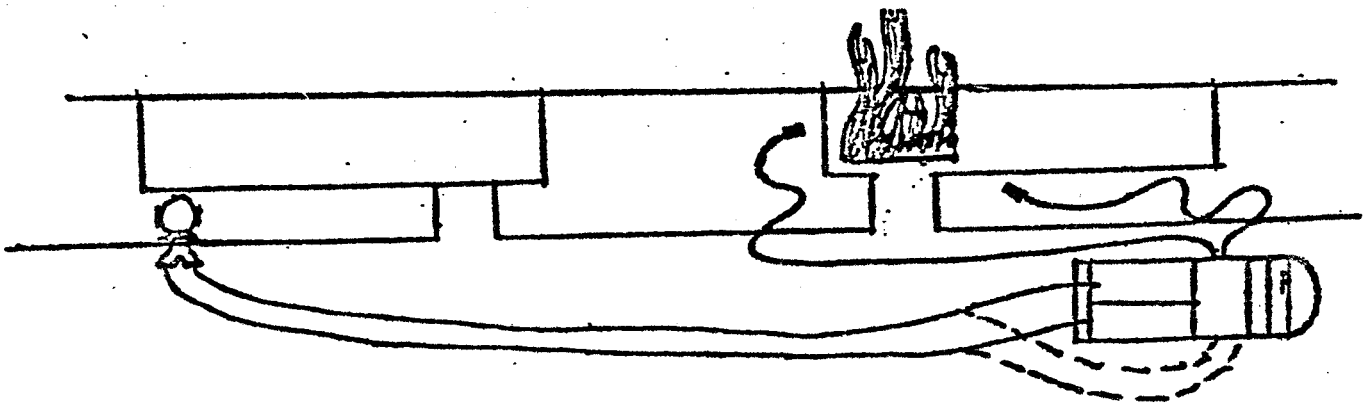
Snubber: FLUSH hydrant, connect supply line(s), slowly charge lines after lines are connected or clamped. Check and secure leaking lines, don a self-contained breathing apparatus and report to the Officer for further instructions.

DOUBLE STRAIGHT $2\frac{1}{2}$"

Two (2) $2\frac{1}{2}$" Fire Lines



SHUBBING HYDRANT



AT THE FIRE

HOSE EVOLUTION

Double Reverse - 2 Firelines (Single Reverse-Same) Manpower 5

FF 3: Comes to a complete stop approximately 15 feet past the fire.

FF 3 and Snubber: Shall remove the following equipment:

1. Self-contained breathing apparatus for all personnel.
2. Complete 1-1/2" bundle.
3. Applicable ladders.
4. Axe.
5. Pike Pole.

FFs: Stretch the fireline(s) using fireline dragging or carrying technique to the area designated by the Officer-In-Charge.

Snubber: To "feed" firefighter stretching fireline(s). Upon completion, return to tailboard and relay "GO" signal to FF 3 using rear buzzer.

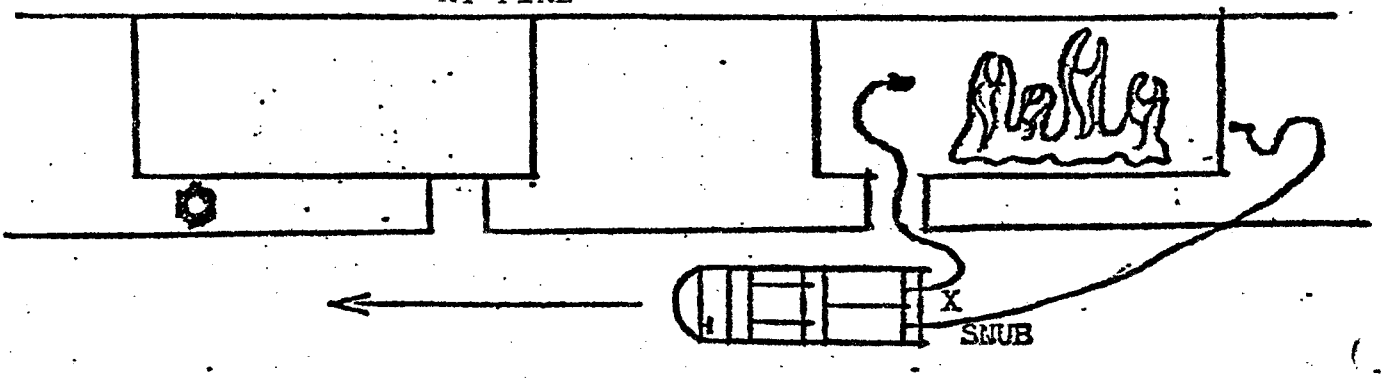
Officer or Designated FF: Utilize bundle(s) or one-man anchoring technique to snub line(s) and signal FF 3 to "GO."

FF 3 and Snubber: Proceed to hydrant and utilize Front or Side soft sleeve hook-up technique.

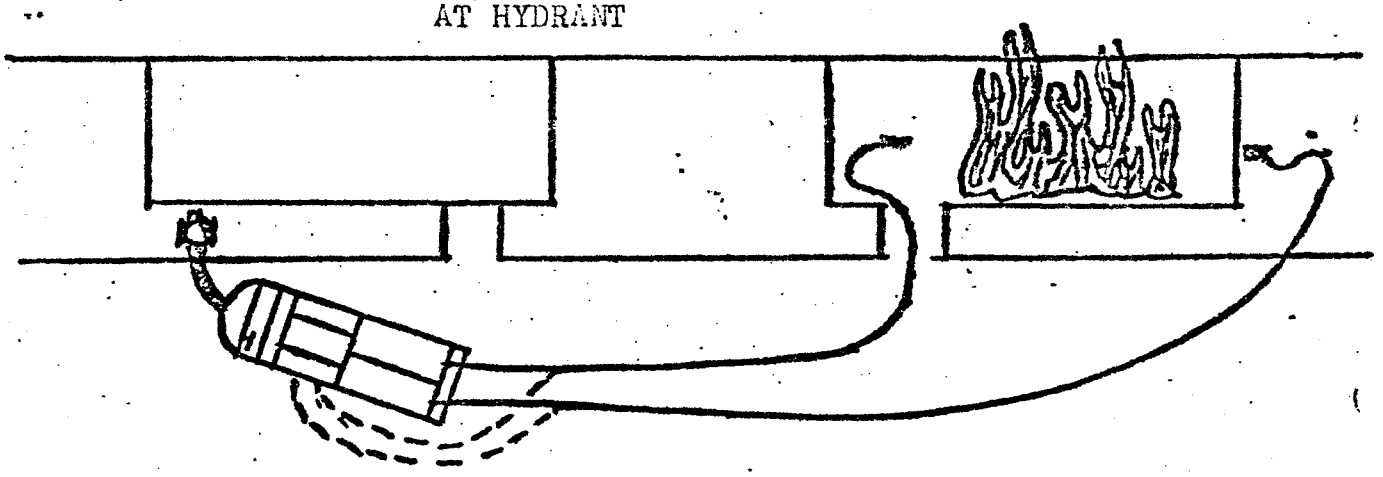
DOUBLE REVERSE $2\frac{1}{2}$"

Note: SNUBBER WILL WEAR BELT SECURED AROUND WAIST WITH ALL APPURTENANCES ATTACHED.

AT FIRE



AT HYDRANT



STANDARD 1-1/2" PRE-CONNECT (REAR)

1. Two 1-1/2" hose shall be pre-connected on the rear discharge, one on each side of the apparatus. The loading of the hose shall be a flat hose load.

2. Lay the hose flat on the right side of the bed from one end to the extreme opposite end of the hose bed.

3. Continue to fold and stack the hose on each other until you have reached the end of the first length, then make a shoulder loop that touches the tailboard and lay the hose to the extreme opposite end of the bed. The hose should continue to be stacked until you have reached approximately 5-6 high and a new row started.

4. Continue to fold and stack in the same manner until you have reached the fourth length, then make a loop as described in Sec. 3, and continue to fold and stack until the last length has been completed. You should have a flat hose load of two rows with 5-6 tiers.

5. Place the nozzle about two feet in the bed facing the discharge, then place each loop in the hose bed.

NOTES

STANDARD 1-1/2" PRE-CONNECT EVOLUTION

1. Facing the hose bed, unfold both shoulder loops.

2. Grasp the nozzle and step off the apparatus, placing the nozzle on top of the shoulder loop designated as the 50 foot working line.

3. While keeping the nozzle and the shoulder loop together (left loop while facing the apparatus), make a 180 degree turn and simultaneously roll your shoulder into the loop.

4. Follow with the opposite shoulder into the other loop.

5. Take the hose slack and proceed to the fire scene until a "tug" on your left shoulder is felt. This indicates that all the hose in the bed has been cleared.

6. Drop the shoulder loop with your nozzle and your 50 foot working line.

1-1/2" PRE-CONNECT TRANSVERSE LOAD

1. Two 1-1/2" hose shall be pre-connected. One on each side of the apparatus. The loading of the hose shall be a flat load. The discharge outlet for the front hose bed shall be used on the left side of the apparatus. The outlet for the rear hose bed shall be used on the right side.

2. While standing on the discharge side of the pre-connect, lay the hose flat on the right side of the bed from one end to the extreme opposite end of the bed.

3. Continue to fold and stack the hose on each other until you have reached approximately 10-15 feet before the end of the first length. A loop on the discharge side shall then be made, 3/4 the distance from the bed to the running board and the hose laid flat to the extreme opposite end of the bed. The hose should continue to be stacked approximately 4-5 high and a new row started.

4. Continue in the same manner until you have reached approximately 10-15 feet before the end of the third length, then make your loop as described in Sec. 3. Continue to stack the hose after you have completed your loop.

   On completion, you should have a flat hose load of two rows with 5-6 tiers or three rows with 4-5 tiers. Narrow hose beds will have two rows, whereas, wider beds will have three.

5. Place the nozzle about three feet in the bed facing the discharge side, then place each loop in the hose bed.

HOSE EVOLUTION

TRANSVERSE 1-1/2" PRE-CONNECT EVOLUTION

1. Facing the hose bed, unfold both shoulder loops.

2. Grasp the nozzle and step off the apparatus, placing the nozzle on top of the shoulder loop designated as the 50 foot working line. The right loops on each side of the apparatus will be your working lines.

3. While keeping the nozzle and the shoulder loop together (left loop while facing the apparatus), make a 180 degree turn and simultaneously roll your shoulder into the loop.

4. Follow with the opposite shoulder into the other loop.

5. Take the hose slack and proceed to the fire scene until a "tug" on your left shoulder is felt. This indicates that all the hose in the bed has been cleared.

6. Drop the shoulder loop with the "tug" and continue to the fire scene with your nozzle and your 50 foot working line.

HOSE EVOLUTION

Portable Deluge-Manpower 1-4

Officer: Directs FF 3 to stop and commands "Deluge Operation." Designate area deluge to be placed.

FF 3 and Snubber: Stretch lines using fireline dragging or carrying techniques less nozzle.

Approximately 30 feet before designated area drop loop(s). Stetch line(s) to area designated for deluge.

Return to apparatus for deluge set and place in designated area.

Snub lines using bundle(s) or one-man method and signal "GO" to FF 3.

At DELUGE

Snubber and FF's: Connect lines to deluge set. (Outside intakes first for tri-mese, inside intakes first for quad-mese.

Lines before intake shall be straight for approximately 25 feet.

At HYDRANT

FF 3 and Snubber: Utilize Front or Side Soft Sleeve hook-up technique.

FF: Utilize dragging or carrying technique to stretch third line directly to deluge and connect to center intake.

FF 3: Charge lines upon command.

Snubber: Check lines for leaks and report to Officer.

HOSE EVOLUTION

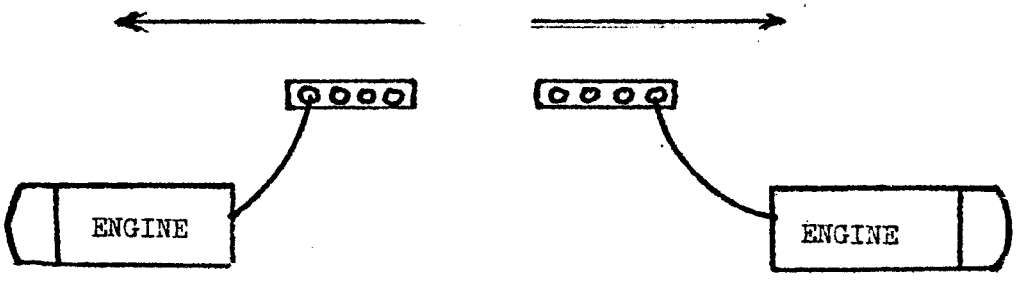
Standpipe Operation

Officer: Gives "Standpipe Connection" command.

FF 3: Comes to a complete stop 10 to 15 feet past standpipe manifold.

Officer and FF 1: Proceed to fire floor to investigate, report and direct operations according to High Rise guidelines.

Snubber and FFs: Stretch lines to Standpipe Manifold using fireline dragging or carrying technique less the nozzle. Approximately 30 feet before manifold drop loops, proceed directly to connection with 2-1/2" butt, open or break away connection caps. Check for blockage and make first connection to outlet in the direction apparatus is moving. On vertical manifolds, connect bottom outlet first.



Snubber or FF: Snub lines using bundle(s) or one-man anchoring technique and signal FF 3 to "GO."

Snubber: Return to tailboard and relay "GO" signal to FF 3 using rear buzzer.

Snubber and FF 3: At hydrant, utilize front or side soft sleeve hook-up technique.

After connection to manifold and hydrant is completed, inform Officer-In-Charge or Incident Commander.

Standby for command to charge standpipe.

FF: To stretch additional lines to manifold, if required.

HONOLULU FIRE DEPARTMENT GUIDELINES TO HELICOPTER RAPPELLING

INTRODUCTION

We have advanced tremendously in our rescue operations during the past 25 years. New equipment and advanced technologies with the assistance of creative ideas have put us where we are today. At times, we have learned through the process of "trial by error." Many of our firefighters have advanced through the ranks gaining their knowledge and experience through this process, however, because of the very nature of our work, this method is highly impractical and is often times dangerous.

Objectives and goals must be thought out and learning must be acquired in advance. Performance standards and the degree of proficiency also must be established before learning takes place. Realism in training is also essential. As a positive learning aid, situations must come close to real life conditions. The rescueman must come close to real life conditions. The rescueman must skillfully operate under controlled conditions similar to real life so his abilities can be accurately observed, rated, and evaluated. To train otherwise is to set up false thoughts and performance standards.

HONOLULU FIRE DEPARTMENT GUIDELINES TO HELICOPTER RAPPELLING

OBJECTIVE

To provide the newly appointed rescueman a standard operating rappelling procedure and the knowledge and skills necessary to perform rappelling evolutions safely. The emphasis of the training sessions is to teach the learner to reach the ultimate goal of rappelling from the helicopter.

PREREQUISITE

The learner must be permanently assigned as a Fire Search and Rescue Squadsman (FSRS) or be on the Firefighter II eligible list as a potential rescueman.

COVERAGE

The subjects will be covered in eight hours of intensive training:

1. Phase I - Introduction to Rappelling
   Phase II - Basic Building Rappelling
   Phase III - Overhang Rappelling
   Phase IV - Helicopter Rappelling

2. Task Performance

3. Performance Standards

4. Instructors Evaluations

Phase I - Two Hours

Introduction to Rappelling

1. Responsibility of the Fire Chief governed by the Honolulu City Charter 1973 Sec. 6-503(b).

2. Types of rappelling ropes, rappelling harnesses and rappelling devices.

3. Basic techniques of making a rappelling harness and the use of various rappelling devices.

4. Proper braking procedure while on a rappel.

5. Basic rappelling procedures from a height of 6-10 feet.

6. Introduction of rappelling from a hose tower (approximately 30 feet) with all available safety precautions:

   - cargo net

   - safety line attached to learner

Performance

Demonstrate the skills and knowledge to don the swiss seat, attach the rappelling device and slide off the life line from the hose tower.

Standards

1. Must be smooth and swift in all phases of the procedures.

2. Must be smooth and swift in donning of the rappelling harness.

3. Must have smooth "kick-off" from the building.

4. Must demonstrate smooth braking to lessen impact of "drop."

5. Must use proper braking procedures.

6. Must have correct body angle of 2 o'clock from ground level.

7. Must be well balanced.

8. Must demonstrate smooth slow descent.

9. Must demonstrate correct "off-rappel" at end of descent.

Evaluation

Practice under close supervision until the learner can consistently rappel with confidence. The evaluator must be confident that the learner has adequate knowledge and skills of the correct procedures before allowing him to perform. Four to six slides are recommended before advancing to Phase II.

Phase II - Two Hours

Basic Building Rappelling

The learner must have all the skills and knowledge of Phase I before advancing to Phase II.

1. Follow rappelling procedures as in Phase I, omitting safety line attached to learner.

Performance

Demonstrate sliding off a life line efficiently from the hose tower.

Standards

Same as Phase I.

Evaluation

The learner must practice under close supervision without the aid of a safety line until he can consistently rappel with confidence. The evaluator must be confident that the learner has adequate knowledge and skills of the correct procedures before allowing him to perform. Four to six slides are recommended before advancing to Phase III.

Phase III - Two Hours

Over-hang Rappelling - McCully Fire Station

McCully Fire Station training tower is the only one of its kind in the Honolulu Fire Department that comes closest to simulating helicopter rappelling.

1. Rappelling procedures:

   - Tie-in rappelling harness and device five feet from ledge.
   - Take-up tension of sliding line.
   - Step back to ledge.
   - Kick-off, positioning body at 2 o'clock from ground level.
   - Brake slowly to lessen impact of free fall.
   - Descend at a slow rate of speed.
   - Proper off rappel.

Performance

Demonstrate the ability to slide off a life line from the tower without supervision. Evaluator must be confident that the learner has the knowledge of the correct procedures before allowing him to perform.

Standards

1. Must be smooth and swift in all phases of procedures.
2. Must be smooth and swift and demonstrate safe application of donning a rappelling harness and the rappelling devices.
3. Must demonstrate smooth kick-off from ledge with the proper body angle while sliding.

4. Must use smooth braking procedures to lessen impact of free fall.

5. Must use correct braking procedures.

6. Must use smooth slow descent.

7. Must demonstrate proper off-rappel.

Evaluation

The evaluator must be confident that the learner has adequate knowledge and skills of the correct procedures before allowing him to perform. The learner must practice until he can consistently rappel with confidence. Four to six slides are recommended before advancing to Phase IV.

Phase IV - Two Hours

Helicopter Rappelling

1. Familiarity of Hughes 500.

2. Proper securing of life line.

   - primary anchoring position

   - secondary anchoring position

3. Proper rappelling procedures.

4. Helicopter rappelling at 20 feet/80 feet.

Performance

1. Demonstrate the proper rappelling procedures while helicopter is at rest. Learner must have the ability and knowledge before advancing to the second phase of the performance.

2. Demonstrate the knowledge and skill of helicopter rappelling progressing from 20 feet to 80 feet over land.

Standards

1. Must demonstrate smooth and safe exiting from the helicopter.

2. Must demonstrate smooth free fall with the proper body angle while sliding.

3. Must demonstrate smooth braking procedures from free fall to lessen impact and shifting of helicopter.

4. Must use smooth slow descent.

5. Must use smooth braking procedures at end of descent.

6. Demonstrate proper off-rappel.

Evaluation

The evaluator must be confident that the learner has the knowledge and skills of the correct procedures before allowing him to perform. If necessary, the learner should practice over water until he can consistently rappel with confidence before allowing him to rappel over land.

Reinforcement

It is important to condition a learner by continously reinforcing the skills he has attained. Repetition establishes a conditioned response. This repetition will aid in the learner's ability to recall the skill rapidly and be able to use it almost instinctively.

Requirements of FSRS

1. Shall perform a helicopter rappel drill once in every two months at 80 feet over land.

2. Shall rappel from the McCully training tower once in every two months.

oOo

A-B-C EXTINGUISHER: Fire extinguishers, the agent of which is listed or approved for use on fires in ordinary combustibles, flammable liquids and electrical fires.

ACCORDION FOLD: A fold for salvage covers

ACCORDION LOAD: Hose loaded into hose compartment by folding back and forth accordion style.

ACKNOWLEDGE: Indicates receipt of alarm when answered from house radio. When "Acknowledge" is given, the responding company need not broadcast "Engine responding." When the word "Acknowledge" is given, it must be preceded by the fire station number and succeeded by the fire station radio identification letters.
Example: Station 17 acknowledge, KDB 477.

ADAPTER: A hose coupling device for connecting hose threads of the same nominal hose size but having different pitch and diameters.

ADVANCE A LINE: Order to move line toward a given area from point where the hose carrying apparatus has stopped.

AERIAL: A mechanically operated turntable ladder attached to a ladder truck and manufactured in various lengths as 65, 75, 85 or 100 ft. aerials. Also referring to complete aerial ladder truck and its ancillary equipment.

AERIAL PLATFORM APPARATUS: Fire fighting apparatus having an aerial platform from which streams can be operated into upper floors and which provide means of access to and egress from a building.

AIR FOAM (MECHANICAL FOAM): Foam for smothering Class B (flammable liquids) fires produced by adding a liquid foaming agent to water to make it capable of foaming in the presence of air introduced by mechanical action in a foam nozzle.

AIR FOAM NOZZLE: A special nozzle incorporating a foam maker to aspirate air into the solution, thus producing air foam.

AIR FOAM STABILIZER: A liquid which is used in a proportion of 3% to 6% in water to produce foam.

AUDITORIUM RAISE: A method of raising ladders with the top supported only by ropes for use inside of auditoriums. A "church raise."

ALL-PURPOSE EXTINGUISHER: A chemical fire extinguisher tested and listed as capable of handling fires in ordinary combustibles, flammable liquids and in electrical equipment.

AMERICAN INSURANCE ASSOCIATION (A.I.A.): Successor to National Board of Fire Underwriters, an organization of fire insurance companies. Conducts surveys of fire protection of principal cities for insurance grading purposes.

ANNUAL LEAVE: The annual vacation time allowed to fire fighters.

ANNUAL REPORT: The annual report of the fire department to the Chief Administrator of the municipality and through that official, to the public which the fire department serves. Such a report includes a record of fire causes and losses, fire fighting, fire prevention and public relation activities, and recommendations for improvements in fire protection.

APPLIANCE: Any of a variety of tools or devices usually carried on a piece of motor fire apparatus.

APPLICATOR: A special pipe or nozzle attachment for applying foam or water fog to fires.

AQUEOUS FOAM-FORMING SOLUTION: A water additive used for controlling flammable liquid fires (See Light Water)

ARSON: The setting of fires to defraud or for other illegal or malicious purposes.

ARSON SQUAD: A squad or detail of police and/or fire officers and fire fighters assigned to investigation of fires of unknown, suspicious or incendiary origin.

ATTACK: The actual physical fire fighting operation utilizing available men and equipment.

ATTACK LINE: Line of hose usually from a pump used to directly fight or attack the fire as contrasted with supply or feeder lines connecting the water supply with the pumping apparatus.

AUDITORIUM RAISE: A method of raising ladders with the top supported only by ropes for use inside of auditoriums. A "church raise."

AUTOMATIC SPRINKLER: Equipment for fire control and extinguishment whereby water is piped to specially designed orifices or sprinkler heads distributed throughout a property and operated automatically in the event of a fire.

AXE: A fire axe, usually having a pick point rather than a flat head oppositethe blade. A flat head axe also may be used by fire departments.

AXE-BELT: Truckman's belt for carrying axe and other tools.

AXLE LOCKS: Locks provided on tractor-trailer type aerial ladder trucks to immobilize the chassis and prevent spring action prior to raising an aerial ladder.

BABY BANGOR: A small extension ladder without ropes or pulleys mostly used inside of buildings.

BACK DRAFT: An explosion or rapid burning of heated gases resulting from the introduction of oxygen when air is admitted to a building heavily charged by smoke from a fire which has depleted the oxygen content of a building. A "back draft" may occur when such a building is opened by the fire department without effecting proper ventilation procedures, or when the fire itself effects an opening.

BACK FLUSH: Flushing of fire fighting equipment with plain water to remove traces of salt water or chemicals used in fighting fires.

BACK-PACK: A 5-gallon pump-tank extinguisher carried on the back with straps and usually having a pump built into the nozzle. Used extensively for grass, brush and woods' fires.

BACK-UP LINE: Ordinarily, a "big line" of 2-1/2 inch hose laid in event the initial attack with small line proves inadequate. Also, an additional hose line backing up the attack and protecting personnel using fog lines for a close attack on a flammable liquids fire.

BALLOONING: To spread a salvage cover over material in a manner that air trapped under cover helps to get cover in place.

BANGOR LADDER: A large extension ladder with tormentor poles for use in raising, of a type developed in Bangor, Maine.

BASE STATION: A fixed radio central dispatching station controlling movements of one or more mobile units on the same radio frequency

BATTALION: A fire department district command headed by a battalion chief on each shift and consisting of a geographical area protected by several fire stations and comprising an average of approximately eight engine ladder or truck, rescue or other fire companies.

BATTALION CHIEF: The Battalion Chief is the lowest ranking chief officer and is the next rank above Captain. The Battalion Chief commands a battalion district on one shift or platoon or carries other comparable responsibilities in the fire department which require the attention of a chief officer.

BATTERING RAM: A heavy metal bar with handles, used to breach walls and other obstructions when it is necessary to gain entrance to attack a fire or to conduct emergency operations such as rescue work.

BEAM: The main structural members of a ladder supporting the rungs or rung blocks.

BEAM MEN: Men stationed at the beams of a ladder during raising or lowering.

BEAM RAISE: To raise a ladder on one side and with one heel in contact with the ground, and usually parallel with the building rather than a flat raise with both heels of the ladder in contact with the ground.

BED LADDER: The lower section of an extension ladder into which the upper sections or fly ladders retract. The lower section of an aerial ladder which beds on to the frame.

BIG LINE: A line of 2-1/2 inch or larger fire hose especially used as a hand line.

BOILOVER: Overflow of flammable liquid from container due either to heating from a fire or due to excessive application of water which may agitate and float the burning liquid over the top of a tank.

BOOSTER: Small line equipment consisting of water tank and pump using 3/4" or 1" rubber covered hose. The 1" size is recommended by NFPA because it carries 4 times the flow of the 3/4" with a given pressure loss.

BREACH A WALL: Opening made in wall to permit operation of hose lines or removal of stock.

BREAK A LINE: A line may be broken to insert a gate or some other device. It is broken where it comes from the hose body in order to attach a nozzle or to attach one end of the line to a pump or hydrant outlet.

BREAK COUPLING: Detaching two pieces of hose by backing the swivel thread (female) off of the nipple thread (male).

BREATHING APPARATUS: Self-contained oxygen or fresh air breathing apparatus having approval of the U.S. Bureau of Mines. As distinguished from filter type masks which merely filter out certain toxic smoke and irritants but do not provide oxygen necessary to support life.

BRESNAN NOZZLE: Trade name of a rotating type distributor nozzle for use in cellar fires.

BRIDGE: To use a fire ladder to span a gap between structures Also a hose bridge to permit traffic to pass over or under lines of hose.

BTU: British Thermal Unit. The amount of heat required to raise the temperature of 1 lb. of water 1 degree F.

BUILDING CODE: Ordinance or ordinances regulating construction of buildings and covering many details such as classification of structures, areas, heights, fire resistance, fire stopping, etc.

BUILDING OF ORIGIN: The building in which an extensive or spreading fire is understood to have started.

BUILDUP: Increase of acceleration of a fire or heat during time after arrival of fire fighters. Also an increase in strength of the fire fighting force.

BURNOUT: A building which has been gutted of virtually all combustible material as a result of fire.

BURST HOSE JACKET: A device designed to be clamped or strapped around a leak in 2-1/2" hose to permit use of the hose to be continued temporarily until it is safe or convenient to replace the burst section.

BUTT: One coupling of a fire hose; the end of a piece of hose; the foot or lower end of a ladder.

BUTTING A LADDER: To place weight of body at the base of a fire ladder in such a way as to provide leverage necessary for raising.

CATCH A HYDRANT: To drop off a man at a hydrant to make a hose connection when laying a line toward a fire.

CHANGE OVER VALVE: A transfer valve on a multi-stage pump or a pressure-volume type pump whereby a pump may be made to provide either rated capacity at specified test pressure or smaller flows at higher pressures.

CHARGED LINE: A line of hose filled with water ready for use and under pressure.

CHECK VALVE: This is a valve designed to permit flow in one direction only but which closes to prevent flow in the opposite direction.

CHEMICAL FOAM: A type of foam designed for smothering Class B fires. It is made by the reaction of an alkaline salt solution and an acid salt solution to form a gas in the presence of a foaming agent which causes the gas to be trapped in tough fire-resistant bubbles.

CHEMICAL LINE: 3/4" rubber covered hose formerly charged by a large soda-acid chemical tank on fire apparatus.

CHIEF: A fire department officer of greather than company officer rank. The Chief of department, Deputy, Assistant or Battalion and heads of service divisions in the department having pay and responsibility commensurate with the title of Chief.

CHIEF OF DEPARTMENT: The highest ranking and commanding fire fighting officer of a given fire department.

CHURCH RAISE: A method of raising a ladder with the top supported by four guy lines so that it may be climbed while not resting against a building.

CHURN VALVE: A pressure relief valve sometimes manually operated which circulates or bypasses water and thus reduces pressure.

CHUTE: A salvage device or arrangement, frequently constructed of salvage covers and other available equipment for the purpose of removing excess water from a burning building. A slide fire escape.

CLAPPER: A hinged valve in a hose control device which permits flow of water in only one direction; i.e., a clapper valve in a siamese connection which closes to prevent escape of water through an unused inlet.

CLASS A FIRE ALARM: A fire alarm system found in large communities where box circuits terminate in a fire alarm central station with operators on duty who receive alarms and retransmit appropriate signals over alarm circuits to the fire department stations.

CLASS A FIRES: Fires involving ordinary combustibles.

CLASS B FIRES: Fires involving flammable liquids.

CLASS C FIRES: Fires involving live electrical equipment.

CLASS D FIRES: Fires involving combustible metals such as magnesium, titanium, sodium and potassium.

CLASS A PUMPER: The present performance standard for fire department pumping engines requiring rated capacity at draft at 150 psi net pump pressure at a lift not exceeding the engine manufacturer's certified peak no load governed speed; and delivering 70% of rated capacity at 200 psi 50% of rated capacity at 250 psi.

CLAW TOOL: A metal forcible entry tool having a hook and fulcrum at one end and a claw blade at the other.

CO_2: Carbon Dioxide released as a gas used for smothering fire (reducing oxygen content of air below point where fire can continue). Fire extinguishing equipment using CO_2 as extinguishing agent, as a CO_2 extinguisher.

COCKLOFT: A low, usually vacant, loft or concealed space between the top floor ceiling of a building and the roof structure.

COLLECTIVE BARGAINING: Bargaining procedures between representatives of the fire fighters (usually a local of the International Association of Fire Fighters) and officials of the government operating the fire department and concerning working conditions, various forms of compensation and fringe benefits.

COMBINATION: A piece of fire apparatus or equipment designed to perform two or more functions.

COMBINATION NOZZLE: A nozzle designed to provide either a solid stream or a fixed spray pattern suitable for flammable liquid fires. An "all purpose" nozzle.

COMBUSTIBLE LIQUID: A liquid with a flash point at or above 100 degrees F.

COMPANY: The basic fire fighting organizational unit headed by a captain and having an Equipment Operator(s) and fire fighters assigned.

COMPANY OFFICER: A captain in command of a fire company unit or on-duty platoon of a fire company.

COMPENSATORY TIME OFF: Time off given in lieu of overtime pay for fire duty or other duty performed beyond the normal contracted work shift or work week.

COMPLEMENT: The entire number of men assigned to a working shift of a fire fighting unit or the entire number of units assigned to any given alarm.

COMPOUND GAGE: A pressure gage on a fire department pumper capable of recording pressures both above and below atmospheric.

CONDUCTION: Heat transfer by direct contact or through an intervening heat conducting medium.

CONFINEMENT: Fire fighting operations required to prevent fire from extending to uninvolved areas or other structures.

CONFLAGRATION: A major fire usually covering a considerable area and one which crosses natural fire barriers such as streets, usually involving buildings in more than one block and frequently resulting in a large loss.

CONSTANT FLOW NOZZLE: A spray type nozzle from which the flow remains constant at a given nozzle discharge pressure regardless of the spray pattern selected.

CONTROLLED BURNING: Burning conducted or permitted for the purpose of abating hazards, removal of undesirable growth and to facilitate the harvest of some agricultural crops.

CONVECTION: Heat transfer by a circulating medium either gas or liquid as air heated by conduction circulates and transfers heat to distant objects in the room.

COVER: To respond to an assignment in place of another fire fighting unit that is not available to meet its normal assignment.

CRACK A NOZZLE: To open a nozzle valve slightly to allow a small amount of water to discharge or to clear air out of a line.

CRASH TRUCK: Specialized fire fighting apparatus designed to handle fires and accidents such as those involving aircraft (airport or airport crash trucks) or vehicles on highways.

CROSS BODY: Equipment such as preconnected lines of hose mounted so as to come off across the apparatus body rather than from a single side or from the rear.

DEAD END: Usually referring to a water main supplied from but one direction or to a hydrant or other fire protection equipment served by such a main as "A hyrant on a 4-in. dead end main."

DEEPSEATED: A fire that has burrowed into baled stocks, grain storage and other combustibles as contrasted with a surface fire.

DEFICIENCY POINTS: Points in the grading schedule charged for deficiencies in community fire protection.

DELUGE SET: A heavy stream device usually consisting of a short length of large diameter hose having a large nozzle with tripod support at one end and a three or four-way "siamese" or inlet connection at the supply end.

DELUGE SYSTEM: An automatic sprinkler system in which water supply to all open sprinklers in a given area is controlled by a thermostatically operated deluge valve.

DEPUTY CHIEF: A high ranking chief officer, usually the second rank in the chain of command under the chief of the department.

DETAIL: Assignment of one or more fire fighters to temporary duty other than with the company to which they are regularly attached.

DETROIT DOOR OPENER: An adjustable forcible entry tool for entering locked doors.

DE-WATER: Methods and equipment used to remove excessive water following fires or flooding, including use of siphons, submersible pumps, portable pumps, etc.

DIAMETER: The length of a straight line passing through the center of an object or plane such as a circle: thickness.

DIRECT ATTACK: Application of hose streams or other extinguishing agents directly upon a fire rather than indirectly attempting to extinguish fire by generating steam to cool heated gases.

DISCHARGE GAGE: A pressure gage recording pounds per square inch discharge of water from a pump. On a centrifugal pump, this is usually a compound gage capable of recording pressures above and below atmospheric.

DISCHARGE GATE: A gate valve provided to control the flow of water from an individual pump outlet or from an outlet of a high pressure hydrant.

DISCHARGE PRESSURE: Normally the pressure in pounds per square inch registered on the discharge side of a pump as contrasted with the pressure on the supply side of a pump.

DISPATCH: To order a fire company to respond to a certain location or signal, usually one to which it was not previously assigned to respond on a given alarm.

DISREGARD: Order to designated units responding to an alarm that their services are not needed and that they may return to quarters.

DONUT ROLL: A 50-ft. length of 1-1/2 or 2-1/2 inch hose rolled up for easy handling. There are various ways of forming the donut. A convenient one has both couplings close together with the male thread protected by the female end or swivel.

DOUBLE FEMALE: A coupling device having two female swivel couplings to permit attaching of male hose nipples when attaching lines laid with couplings in opposite or reverse directions.

DOUBLE HYDRANT: A hydrant barrel having two outlets usually two 2-1/2 in. but occasionally, having one or two "steamer" outlets replacing one or both of the usual 2-1/2 in. outlets.

DOUBLE JACKET HOSE: Fire hose having two cotton or other fibre jackets outside the rubber lining or tubing.

DOUBLE LAY: A hose laying operation at fires in which more than one line of hose is laid by a unit. Dual lines may be laid from a divided hose body or hose may be laid in each direction between fire and water supply.

DOUBLE MALE: A device having two male thread nipples for connecting hose and for connecting two female swivel couplings.

DRAFT: To draw water from static sources into a pump which is above the level of the water supply. This is done by removing the air from the pumpt and allowing atmospheric pressure (14.7 psi at sea level) to push water through a non-collapsible suction hose into the pump. It is sometimes also necessary to draft from a booster tank.

DRILL: To practice fire fighting evolutions such as laying hose, raising ladders and operating pumps in order to develop teamwork and proficiency.

DRILL MANUAL: Official test, usually illustrated, setting forth how certain firefighting evolutions are to be performed in a given fire department.

DRILLMASTER: A fire department officer normally a member of the training division or staff who is responsible for supervising drills including company drills and basic training for probationary fire fighters.

DRILL TOWER: A training structure usually from three to six stories in height having stairway, fire escape, standpipes and other structural features necessary in training fire fighters and company units in basic hose, ladder and rescue techniques.

DRY CHEMICAL EXTINGUISHERS: Dry chemical extinguishers are portable hand, wheel-mounted or apparatus, mounted appliances of stored pressure or cartridge operated types. In the cartridge operated type, the dry chemical is expelled by carbon dioxide or nitrogen stored in a separate gas expellant cartridge.

DRY HYDRANT: A permanently installed suction pipe or connection with proper thread to permit a fire department pumper to take suction from static water source as at a bridge, pier or farm pond.

DRY STANDPIPE: ~~A dry pipe automatic sprinkler system having air under pressure in sprinkler piping installed in areas that might be subject to freezing~~.

DRY VALVE: A valve of a dry pipe automatic sprinkler system in which air under pressure keeps the valve seated and keeps water out of sprinkler piping until heat operates a sprinkler to release the air.

DUAL LAY: Laying two lines of hose simultaneously with a given unit.

DUAL LINES: Two lines of hose, in some cases, delivering separate extinguishing agents for combined effect, but more commonly to provide the desired capacity to a pumper or nozzle.

DUMP FIRE: Fire in a refuse disposal area. Frequently such fires are difficult to extinguish and are accompanied by offensive smoke and odors.

DUST EXPLOSION: An explosion of any combustible dust such as flour, wood floor, finely divided metals, etc.

EDUCTOR: Equipment provided for drawing foam concentrate or wetting agents into hose streams.

ELEVATING PLATFORM APPARATUS: A mechanically raised platform mounted on fire apparatus and designed for rescue and fire fighting service. The platform may be on an articulated (folding) boom or on a telescopic boom.

EMERGENCY: A situation usually arising from lack of adequate foresight or preparation or from abnormal weather conditions.

EMERGENCY VEHICLES: Vehicles carrying personnel or equipment for dealing with emergencies and including fire apparatus and official fire chiefs' automobiles.

ENFORCING AUTHORITY: The Fire Chief, Building Official or other officer or agency having legal enforcement responsibility.

ENGINE: A fire department pumper or pumping engine.

ENGINE COMPANY: A fire company equipped with one or more pumping engines or "pumpers" having rated capacities of 500 gpm or more.

ENGINEER: A fire protection or fire prevention engineer.

"ENGINEER": A pumper operator or licensed fireboat engineer.

ENROUTE: Word used regarding events occuring while the apparatus is responding to an alarm.

EVOLUTION: An agreed operation sequence requiring teamwork and covering various basic firefighting tasks such as the placement of hose and ladders.

EXCESSIVE HEAT: Temperatures generally in excess of 300 degrees Fahrenheit which tend to vaporize exposed fuels and enables fire to spread.

EXISTING: Buildings, structures or facilities already in existence at the time when specific legislation went into effect.

EXIT: A way of departure from the interior of a building or structure to the outside at ground level.

EXPANDER: Device for expanding the expansion rings used for securing fire hose to couplings.

EXPANSION RING: The metal ring that holds fire hose securely to the tail piece of a coupling.

EXPOSURE: Property that may be endangered by a fire in another structure or by a fire in another room within a structure.

EXTEND: A line may be extended by adding hose beyond the nozzle by attaching hose to the nozzle tip thread (usually reduced to smaller diameter) or by removing nozzle and attaching donut rolls.

EXTENSION LADDER: A ladder of two or more sections which may be extended to various heights. The extension ladder has a bed ladder and one or more fly ladders, the top being the tip.

EXTINGUISH: To put out flames but essentially to completely control the fire so that no abnormal heat or smoke remains. To quench.

EXTINGUISHER: Portable first-aid fire fighting devices approved for use on certain types and classes of fires.

FALSE ALARM: An alarm for which no fire existed or for which fire department response was unnecessary or due to accidental operation of fire alarm devices, generally, a malicious false alarm.

FALSE CEILING: A suspended ornamental ceiling below the true or original frequently forming a concealed space through which fire may spread.

FALSE FRONT: An ornamental building facade covering windows, concealing combustible construction and hindering access and ventilation by fire fighters.

FEEDER LINE: A line of hose from a source of water supply used to supply pumping apparatus stationed near a fire from which water is discharged through leader lines or deluge guns. A supply line as contrasted with a fire fighting or attack line.

FEELING FOR FIRE: Using the sense of touch to locate excessive heat where flame may not be visible, as in walls or partitions or in forest fire fuels.

FEMALE COUPLING: A swivel coupling made to receive a male hose nipple of approximately the same thread pitch and diameter.

FILL-IN: Dispatch of other units to replace companies not available to answer their regular assignments.

FINGERS OF FIRE: Long narrow projections of fire extending from the main body of a forest or brush fire.

FIRE: A usually unintentional or undesired burning, rapid oxidation of combustible materials resulting in light and heat.

FIRE ACADEMY: An extensive fire department training facility as maintained in certain large cities.

FIRE ADMINISTRATION: The managerial phases of fire department organization. Also educational courses involving administrative and management aspects of fire department organization.

FIRE ALARM BUREAU: Fire alarm headquarters from which all fire alarm signals are transmitted and all units are dispatched and where records are kept of the movements of all fire units.

FIRE ALARM SYSTEM: A communications facility for fire protection purposes designed to receive alarms of fire and other emergency calls handled by the fire department and to transmit the calls to units designated to respond.

FIRE AXE: An axe having a pick point on the opposite side of the head from the cutting blade.

FIRE BEHAVIOR: The manner in which fuel ignites, flame developes and fire spreads.

FIREBOAT: A vessel equipped as a marine fire engine having pumps, hose, monitor or turret nozzles and usual engine and ladder company fire fighting gear.

FIRE BRIGADE: The fire service organization of an industrial plant or private institution as distinguished from the public fire department.

"FIREBUG": In general, a rather indefinite uncomplimentary term for persons suspected of setting fires: an arsonist.

FIRE BUILDING. A building or structure in which fire is in progress or has occurred and therefore a structure which is the subject of fire fighting operations and investigations, as distinguished from exposures. The building in which the fire originated.

FIRE CHIEF: The chief of a fire department; a chief officer.

FIRE COAT: A waterproof protective coat having ring snap fasteners for quick donning, wrist protectors and frequently a detachable winter lining.

"FIRE COMMAND": A monthly periodical published for the fire service by the National Fire Protection Association.

FIRE CONTROL: The art of controlling an unwanted or "unfriendly" fire as contrasted with fire prevention, or complete extinguishment.

FIRE DEPARTMENT: Public fire protection organization providing fire prevention, fire extinguishment and emergency rescue service in a given jurisdiction such as county, municipality, or organized fire district.

FIRE DEPARTMENT CONNECTION: Supply connections to automatic sprinkler and standpipe systems permitting fire departments to pump into private fire protection systems.

FIRE DETECTION SYSTEM: A system for detecting the presence of abnormal fire or heat.

FIRE DOOR: A tested, listed or approved door and door enclosure constructed for the purpose of preventing the spread of fire through a standard fire wall, partition, vertical or horizontal opening.

FIRE DUTY: Actual physical engagement in fire fighting service as distinguished from staff work at headquarters or maintenance division.

FIRE ESCAPE: An emergency means of escape from a building in event of fire, with special reverence to an exterior stairway usually of iron construction.

FIRE FIGHTER: An active member of a fire department; a term more specifically used of paid career fire fighters as contrasted with volunteer fire fighters.

FIRE FIGHTING: Fire extinguishing operations as distinguished from fire prevention and other means of reducing losses from fire.

FIRE FLOW: The quantity of water available or used for fire protection in a given area and normally measured both in gpm and as to specific duration of flow.

FIRE FLOW, APPLIED: The maximum or peak rate in gpm at which water actually is applied on a specific fire. Includes discharge from various nozzles used, sprinklers and other private fire protection equipment.

FIRE FLOW, AVAILABLE: The rate of flow in gpm shown by flow tests conducted at hydrants in a given area available for fire protection purposes as contrasted with recommended or desired fire flow.

FIRE GROUND: The operational area at a fire at which the ranking fire officer is in charge of all operations and at which fire fighting is underway at which fire fighting apparatus is standing by.

FIRE HAT: A fire fighter's helmet.

FIRE HOUSE: A fire department station housing fire department apparatus and fire department members while on duty. A "fire station".

FIRE INVESTIGATION: Activity concerned with determining the cause of fires, especially illegal burning.

"FIRE JOURNAL": Official publication of the National Fire Protection Association, published bi-monthly.

FIRE LINES: Boundaries established by police around a fire area to deny access to all by emergency vehicles and persons having official business in the area.

FIRE LOADING: The weight of combustibles per square foot of floor area.

FIRE FIGHTER: A fire department member, whether permanent (full-paid), call (part-paid) or volunteer (unpaid). A smokechaser or fire patrolman.

FIREFIGHTER'S CARRY: A method of lifting and carrying a disabled or unconscious person to a place of safety. The patient is carried over the shoulders and held by one hand leaving the firefighter a free hand for descending ladders, etc.

FIREMANIC: Pertaining to the fire fighting service.

FIRE MARSHAL: The chief fire prevention officer of a state, province, county or municipality.

"FIREMEN": Monthly magazine formerly published by NFPA for the fire service. Superseded by new publication "Fire Command".

FIRE PREVENTION: That part of fire protection activities exercised in advance of the outbreak of fire to prevent such outbreaks and to minimize loss when fire does occur.

FIRE PREVENTION BUREAU: A bureau of division of a county, municipal or other fire service agency engaged in fire prevention and investigation rather than fire extinguishment.

FIRE PREVENTION CODE: Municipal ordinance or ordinances enacting fire safety regulations; preferably following model requirements of NFPA and AIA and usually supplementing a building code covering structural features for fire safety.

FIRE PREVENTION WEEK: A week proclaimed by the President of the United States devoted to fire prevention activities. Usually the week including the anniversary of the Chicago Conflagration of October 9, 1871.

"FIREPROOF": A misnomer. Refer to fire resistive.

FIRE PROTECTION: The science of reducing loss of life and property by fire including both fire prevention and fire extinguishment by public or private means. Also, the degree to which such protection is applied.

FIRE PROTECTION HANDBOOK: An extensive reference work covering virtually all phases of fire protection and published since 1935 by the NFPA.

FPRI: Fire Protection Research International. A corporation affiliated with NFPA to encourage fire protection research on an international basis.

FIRE PUMP: A stationary water pump listed or approved for private fire service, usually gasoline engine, diesel or electric driven. These pumps are available with various characteristic curves and volume ratings. Distinguished from a "pumper" which is an automobile pumping engine used for fire department service.

FIRE REPORT: An official report of a fire incident giving date, time, place, owner, occupant or tenants, construction, location, cause, if ascertained, fire fighting action taken by unit or units employed, personnel responding, officer in charge, extent of damage and other pertinent details.

FIRE RESISTANCE: A relative term often used with a system of rating to indicate the extent to which a material or structure resists the effects of fire. For example, two hours fire resistance as measured on the standard time-temperature curve.

FIRE RESISTIVE: The property or design of a structure or assembly of materials built to provide a predetermined degree of fire resistance usually as called for by building and fire prevention codes variously calling for construction capable of 1-hr., 2-hr or 4-hr. fire resistance.

FIRE RETARDANT: A survace or construction that will retard the spread of fire giving fire fighters a reasonable chance to control an unfriendly fire.

FIRE SCHOOL: A fire department training school where various types of fires are conducted to familiarize officers and company units with the most efficient methods of extinguishment and control.

FIRE SERVICE: The organized fire prevention and fire fighting service; its members individually and collectively and allied organizations assisting fire fighting and fire prevention agencies.

FIRE SERVICE TRAINING: Procedures for training fire department personnel in various phases of fire fighting and fire prevention activity starting with probationary firefighter's training, company drill school, pump operators' training, and officer training or fire college.

FIRE SCIENCE: Courses in fire service technology given at over two hundred colleges and universities in North America to prepare fire department personnel for their professional responsibilities.

FIRE STOPPING: The blocking off of concealed spaces of structures to prevent unseen extension of fire throughout walls and ceilings.

FIRE STORM: An atmospheric disturbance resulting from hundreds of simultaneous fires such as may occur during incendiary bomb raids. Violent convective system caused by a large area of intense fire and usually encompassing the entire fire.

FIRE STREAM: A stream of water used in fighting fires.

FIRE SUPPRESSION: a term used relative to control of forest fires where suppression rather than direct extinguishment of the entire fire often is practiced.

FIRE TO HYDRANT LAY: Hose laid from the fire to the water supply. Hose may be carried on the apparatus with nozzle attached and loaded with male coupling leading off at fire. In some areas where hose is loaded to lead off with a female coupling, this would require a straight lay.

FIRE TOWER: A self-contained structural stair tower used as a fire escape for building occupants and as a means of access for fighting fires. Frequently containing a fire department standpipe riser. A fire department training tower; a fire department communications center. Occasionally, a fire department water tower truck or an aerial ladder employed as a water tower.

FIRETRAP: A structure which due to interior arrangement, contents, lack of private protective equipment and inadequate exits is considered likely to contribute to a major loss of life in the event of fire.

FIRE TRIANGLE: Three factors necessary for combustion and flame production are oxygen, heat, fuel -- the three legs of a triangle. With any one of these removed, flame production ceases. However, a few fuels supply their own oxygen and even where oxygen is not present in sufficient quantity for active flame production, excessive heat will result in damage or destruction of many materials.

FIRE TRUCK: Any piece of motorized fire fighting apparatus; a ladder truck.

FIRE WALL: A solid wall of masonry or other non-combustible material capable of resisting fire or a prescribed period. The wall should extend through the roof and have parapets to prevent fire from overlapping.

FIRE WHIRLWIND: A revolving mass of air caused by a fire which may have sufficient intensity to snap off large tress.

FIRST ALARM: The initial alarm but more specifically, the first fire alarm signal calling for a normal first alarm response in the district where the fire is located.

FIRST ARRIVAL: The first designated response unit or officer to report at the scene of a fire.

FIRST-IN: First to arrive at a designated location.

FIRST LINE: Apparatus or fire company units normally answering fire calls. Usually the latest fire fighting appliances manned by the regular on-duty force as contrasted with reserves.

FLAILS: Various swatters for attempting to beat out forest and brush fires. Usually of limited effectiveness. Brush beaters.

FLAKED HOSE: Hose carried in loose folds either on the apparatus or manually as contrasted with rolled hose or tightly packed hose loads.

FLAME: The light from burning gases and incandescent particles during a fire.

FLAME RESISTANT: Material or surface of a nature that does not propagate flame once an outside source of flame has been removed; Flame retardant.

FLAME SPREAD: The rate at which flames spread over surfaces of various materials such as building finishes, fabrics, etc.

FLAMMABILITY: The relative ease with which various fuels ignite and burn, regardless of the quantity of fuel involved.

FLAMMABLE: Capable of burning or producing flame at ordinary temperatures, of being easily ignited. Less desirable term, "inflammable".
Antonym: Nonflammable

FLAMMABLE LIMITS: The highest and lowest volumetric percentages or concentrations of a flammable gas or vapor with the oxygen in the air that will explode or ignite.

FLAMMABLE LIQUIDS: Refers to any liquid having a flashpoint below 100 deg. F.

FLAMMABLE RANGE: The range between the upper and lower explosive limits of a flammable vapor or gas.

FLASHBACK: Tendency of flammable liquids fire to flash from source of ignition back to flammable liquids container. Also reflash where flame of flammable liquids fire has been extinguished but flammable vapors are subject to reignition from heated objects.

FLASH FIRE: A type of fire which spreads with almost explosive rapidity. Many so-called "explosions" are actually flash fires resulting from ignition of highly flammable substances such as flammable liquids and gases.

FLASHOVER: State of fire when room or other area becomes heated to the point when flames flash over the entire surface or area.

FLASH POINT: The temperature at which a liquid gives off sufficient vapors to form an ignitible mixture with air near the surface or in a container.

FLAT LOAD: Hose laid flat in hose body rather than on the edge which is the most common practice. Flat loads are said to play out more smoothly but require more frequent changing to prevent damage to the hose.

FLOODLIGHT: Large or powerful electric lighting equipment used to provide diffused light on the fireground. Frequently powered by a portable electric generator or special lighting trucks.

FLY: The upper sections of an extension or aerial ladder. The top of the ladder.

FOAM: Compounds introduced into a stream of water by special nozzles or proportioning devices to develop a stream of tenacious foam capable of smothering fires, especially those involving flammable liquids. Also the foam produced by such equipment.

FOAM BLANKET: The covering of foam applied over a burning surface for smothering effect.

FOAM GENERATOR: Devices for mixing chemical foam powders with a stream of water to produce foam.

FOG: A jet of fine water spray discharged by spray nozzles, used to extinguish fire. Generally considered most efficient at nozzle pressures of approximately 100 psi.

FOG CONE: The angle at which water spray leaves a fox nozzle usually taken as two opposite sides of the jet with the orifice as the base of the angle. Fog cones are referred to as 30 deg., 60 deg., 90 deg., etc.

FOLD: Any one of several methods of folding salvage covers so that they can be spread by one man.

FORCIBLE ENTRY: Techniques used by fire departments to get buildings which apparently are closed and locked with a minimum of delay and property damage. Forcible entry tools include various patented tools, door openers, the fire axe and a claw hammer.

FRAME: Construction in which exterior walls, bearing walls and roofs and their supports are wholly or partly of wood or other combustible material.

FREQUENCY: Specific radio wave lengths assigned for certain operations such as fire service.

FRICTION: Term commonly applied to loss of pressure in fire hose, pipe or fittings. Actual friction is due to friction between the moving water and the inside of the pipe or hose but in common usage the term includes the energy required to move a given weight of water the specified distance. Friction loss normally is measured in pounds per square inch per 100 ft.

"FRIENDLY" FIRE: A fire lighted by owner or occupant for desirable purposes as for heat but which may inadvertently result in smoke or water damage to property without actual extension of the flame.

FUEL: Combustible material adding to the magnitude or intensity of a fire or combining with oxygen to contribute to the burning process. One of the three essentials in the fire triangle of oxygen, heat and fuel.

FULL ASSIGNMENT: The full complement of companies and apparatus (pumper, ladder, squad and other companies and chief officers) indicated on the printed assignment card for a given location.

FULL RESPONSE: Response of total units assigned for 1st alarm structural fires at the particular location.

FULLY INVOLVED: The entire area of a fire building so involved with heat, smoke and flame that immediate access to the interior is not possible until some measure of control has been obtained with hose streams.

FUSED HEAD: Atuomatic sprinkler which has operated or fused.

FUSIBLE LINK: A connective link device used to permit operation of fire protection devices when heat causes the fusible link or element to melt releasing a weight or valve.

FUSIONABLE: Capable of fusing. Especially materials capable of use in processes calling for fusion of nuclei of atoms for relasing atomic energy.

GAGE OR GAUGE: A device giving visual indication of pressure, motor speed, etc.

GALLON: U.S. gallon consisting of 231 cu. in. of water weighing 8.336 lbs. An imperial gallon is 1.201 U.S. gallons.

GASKET: The rubber or synthetic sealing ring necessary in female or swivel hose coupling to make a water-tight connection. The firefighter must always make certain that the gasket is in place and in good condition when making up a coupling.

GATE: A control valve for hose, a pump outlet or a large calibre nozzle. A gate valve.

GATE VALVE: A controlling valve for hose or pump outlet or large calibre nozzle.

GATING A HYDRANT: To attach an independent valve to hydrant outlet before turning on the hydrant. This permits use of other outlets without shutting the main hydrant valve.

GENERAL ORDER: An order issued by the Chief to expand or amend the Rules and Regulations of the Department. Each General Order will bear a serial number and shall be effective until cancelled by revision of the Rules and Regulations. Each member shall receive a copy of each General Order.

GOING FIRE: A current fire between the time of receipt of alarm and that when officially declared out.

GOVERNOR: A device used to regulate pump discharge pressure by controlling the speed of the gasoline engine driving the pump. The governor is set to give a desired maximum pressure and slows down the motor when nozzles are shut down in order that the pressure on other lines and in pump and hose will be kept within safe limits.

GPM: Gallons per minute, the measure of water flow in fire fighting; used to measure output of fire department pumpers, hose streams, nozzles, hydrants, water mains, etc.

GRADING SCHEDULE: "Standard Schedule for Grading Cities and and Towns of the Unites States with reference to their Fire Defenses and Physical Conditions", a document copyrighted by the American Insurance Association and used by underwriters' engineers to measure the physical fire defenses of communities. (Refer to NFPA Fire Protection Handbook, fourteenth edition, pp. 9-78 for deficiency points in each category.)

GRASS FIRE: Fire involving dried grass which may present a severe exposure hazard to valuable property.

GRAVITY TANK: A water storage tank for fire protection and sometimes community water service. A water level of 100 ft. provides a static pressure head of 43.3 psi minus friction losses in piping when water is flowing.

GRID: A water main or piping system with lateral feeders or arteries to strengthen the supply and improve the distribution of water with minimum pressure loss due to friction.

GRIEVANCE: A labor term denoting a situation or condition involving fire fighters individually or collectively where there is dissatisfaction with the way a given situation has been handled by management and requiring negotiation or in some cases arbitration.

GROSS VEHICLE WEIGHT (GVW): The actual vehicle weight which is the sum of the weights of chassis, body, cab, equipment, water, fuel, crew and all other load.

GROUND JACK: A heavy jack attached to the frame or chassis of an aerial ladder truck to provide stability when the ladder is raised. On soft ground a metal plate should be placed under the jacks to increase the bearing surface area.

GROUND SPILL: Spill of flammable liquids over a surface providing ready vaporization with danger of ignition and flash fire. This presents a fire protection problem which may require blanketing with foam or washing with hose streams.

H.A.D.: Heat Actuated Device. A thermostatic device used to actuate fire protection equipment.

HALF LIFE: The period of time required for any radioactive material to lose half of its potential or present energy.

HALLIGAN TOOL: A forcible entry tool of many uses developed by Deputy Chief Halligan of New York City.

HANDIE-TALKIE: A two-way radio hand set used for fire ground communications.

HAND LINE: 1. A light rope used in hoisting fire tools and securing objects. Contrasted with "life line" thought of primarily as a rescue device.
2. A line of 1-1/2" or 2-1/2" hose handled manually by hosemen rather than through fixed heavy stream devices.

HARD SUCTION: Non-collapsible suction hose for drafting water from static sources lower than the pump. Most common size is 4-1/2" internal diameter. A 4" size is permitted on 500 gpm pumps but this size is less efficient. 5" and 6" sizes are available for large capacity pumpers.

HARRASSMENT: Abuse of and physical attacks upon fire fighters in the performance of their duties. Frequently associated with civil disturbance and unrest.

HAZARD: A condition of fire potential defined by arrangement, size, type of fuel and other factors which form a special threat of ignition or difficulty of extinguishment.

HEAD: Pressure due to elevation of water sometimes termed "back pressure" by fire fighters, amounting to 0.433 lbs. per ft. of elevation. A 100 ft. elevation of a water storage level will give 43.3 lbs. static head and 231 ft. elevation is equal to 100 lbs. pressure head.

HEADQUARTERS: The administrative offices of a fire department; the administrative personnel collectively; the office of the chief of department; fire alarm or communications headquarters; the central fire station.

HEAT: Temperatures above the normal atmospheric, as produced by the burning or oxidation process.

HEAT TRANSFER: Movement and dispersion of heat from a fire area to the outside atmosphere by converting water fog particles to steam thus expanding the volume 1650 times and creating a slight pressure carrying the heat and heated water vapor outside.

HEAVY DUTY EQUIPMENT: Master stream equipment with large tips for use at major fires; apparatus or equipment assigned to develop such streams.

HEAVY STREAM: A large calibre stream too heavy for convenient manual operation and discharged through a monitor nozzle, deluge set, ladder pipe, turret pipe. A stream of 400 to 1200 gpm or more.

HEEL: The base of a ladder; the heel plates. To take a position at the base of a ladder for raising or lowering; to heel a ladder.

HELMET: The regulation protective headwear for fire fighters usually carrying insignia of unit and rank. Traditionally of leather but also of aluminum, and various composition material. A fire hat.

HIGBEE CUT: The first or outside thread of a hose coupling or nipple is removed to prevent crossing or mutilation of threads.

HIGH EXPANSION FOAM: Equipment and liquid foam concentrates variously designed to provide foams at expansion rates of 100 to 1 up to 1,000 to 1. Such foams have a rapid build-up and are used for flooding fire areas as well as for blanketing flammable liquids fires.

HIGH PRESSURE: A system of separate fire service water mains having hydrants with independent gates, and providing large flows at high pressure in high value districts of large cities without using mobile fire department pumpers. Most of these systems have been extended but little since the advent of motor pumpers which permit fire departments to amass more than ample pumping capacity at any spot without the maintenance of a separate fire main and pump system.

HIGH PRESSURE FOG: A small capacity spray jet produced at very high pressures and discharged through small hose having a gun type nozzle. Also, the equipment producing high pressure fog. This was originally an adaptation of the orchard sprayer for fire fighting but more recently many fire department pumps have been built with additional pressure stages which provide increased pressure instead of volume.

HIGH PRESSURE PUMPER: Loosely, a pumper having special high pressure stages or equipment for small high pressure streams. Also a pump purchased under specifications calling for a discharge of stated quantities at pressures higher than required for normal pump performance.

HIGH TEMPERATURE SPRINKLER: An automatic sprinkler normally set to operate at 212 degrees Fahrenheit, 286 degrees Fahrenheit or 360 degrees Fahrenheit for solder type sprinklers and somewhat lower temperatures for non solder types. Designated as "Intermediate", "High" and "Extra High" and colored white, blue and red respectively. Some very high temperature non-solder sprinkler heads available for 400 degrees and 500 degrees Fahrenheit operation are colored green and orange.

HIGH VALUE COMPANY: A fire company serving a high value district so designated in city survey reports by the American Insurance Association.

HITCH: One of a variety of methods of securing objects with rope as chimney hitch, clove hitch, etc. Also, to take a hitch around a hydrant with hose so that the hose will not pull away when the apparatus proceeds towards the fire.

HOIST: To raise an object as to hoist an extinguisher or ladder by a rope or halyard. Also, the raising mechanism of an aerial ladder as "spring hoist" or "hydraulic hoist".

"HOOK AND LADDER": Historical term used in some fire departments to designate ladder or truck company apparatus.

HOOKING UP: Connecting a fire department pumper to the hydrant and connecting discharge hose.

HORSESHOE LOAD: Hose loaded around the hose compartment in form of horseshoe shaped loops.

HOSE: Fire hose in various standard sizes: 1 inch, 1-1/2 inch, 2-1/2 inch, 3 inch,4 inch, 4-1/2 inch, 5 inch and 6 inch nominal diameters.

HOSE BODY: The main body compartment of a pumper or other fire apparatus carrying 2-1/2" or other large fire hose. A standard hose body has capacity for 1500 feet of 2-1/2 inch double-jacket fire hose plus compartments for 400 feet of 1-1/2 inch fire hose.

HOSE BRIDGE: Devices or arrangement for allowing traffic to pass over fire hose or to elevate hose over traffic.

HOSE CLAMP: A device for shutting off the flow of water through fire hose.

HOSE DRYER: An enclosed metal cabinet with racks on which fire hose is dried by an electrical heater at safe temperatures.

HOSE JACKET: The woven jacket or jackets of cotton or synthetic fibres with which fire hose is constructed whether lined or unlined.

HOSE LINE: A short rope used to secure hose to ladders, etc. Also variation of "line of hose".

HOSE LOAD: One of a number of different methods of loading hose into the hose body of a fire truck such as "accordion load".

HOSEMAN: A fire fighter assigned chiefly to hose duties with a hose, pumper, pumper-ladder company or any fire fighter performing such duties at a fire.

HOSE RACK: Rack for storing or drying fire hose.

HOSE REEL: Hand drawn hose reels as used in industrial fire protection, permanently mounted reels for fire hose installations; also, booster reels on fire apparatus.

HOSE ROLLER: A metal device having rollers used to protect hose and make it easier to pull hose over cornices and window sills.

HOSE ROPE: A rope with an eye-splice or metal ring on one end and usually a hook on the other used to secure hose to ladders or other objects.

HOSE STRAP: A strap with hook at one end and eyelet at other used to secure hose to ladders and other objects.

HOSE STREAM: A stream of water from a nozzle attached to a line of fire hose or a heavy stream device supplied by fire hose.

HOSE WAGON: A fire truck chiefly used to carry fire hose and usually equipped with a booster pump of less than 500 gpm capacity. Also, a pumping engine used as a hose wagon with a two-piece engine company.

"HOT AIR EXPLOSION": A loose term for a back draft or smoke explosion. Hot air itself would not explode without the ignition of heated gases. Heated air may temporarily exert a very slight pressure.

HOT SPOTS: Places in fires where concentrations of burning fuel requires special attention.

HOUSE LIGHTS: Lights provided throughout a fire station and controlled from the floor or office area making it possible to illuminate the entire station when the company or unit to respond to an alarm. Sometimes house lights are automatically actuated by the alarm burea.

HOUSE LINE: Private fire hose permanently attached to a standpipe system as contrasted to fire department hose attached at time of fire.

HYDRANT: A valved outlet to a water supply system with one or more threaded outlets to supply fire department hose and pumpers with water.

HYDRANT DISTRIBUTION: Effective distribution of fire hydrants is to permit the application of fire flows estimated to be needed without having hose of excessive lengths.

HYDRANT GATE: Valve connection to permit control of a hydrant outlet independent of the main control valve.

HYDRANT HOUSE: A small house built around an industrial plant yard hydrant containing fire hose, nozzles, axes, spanners lanterns and other basic fire fighting tools.

HYDRANT STEM: The operating stem extending from the operating nut at the top of a hydrant to the valve near the base of the hydrant usually well below frost level.

HYDRANT TO FIRE LAY (STRAIGHT LAY): Hose laid from hydrant or water supply to the fire.

HYDRANT WRENCH: A special wrench necessary to turn on hydrants usually having a pentagonal operating nut and also used for removing caps from hydrant outlets.

HYDRAULIC HOIST: A power-operated mechanism or system employed for operating various forms of fire department equipment including aerial ladders, elevating platforms and tower-ladders. Power is transmitted by oil under pressure.

HYDRAULIC RAM: Device employed to level an aerial ladder where it must be placed on a steep grade.

HYDRAULICS: The study of the use and movement of water, especially as pertaining to the extinguishment and control of fires.

HYDROMECHANICAL HOIST: An aerial ladder mechanism using hydraulic power to elevate the ladder but using other mechanical means to rotate the turntable and extend the fly ladders.

IAFC: International Association of Fire Chiefs, with voting members limited to chiefs of fire departments and industrial fire brigades in the United States and Canada, and associate membership open to assistant chiefs, fire fighters and others interested in the fire service.

IAFF: International Association of Fire Fighters, an American Federation of Labor--Congress of Industrial Organizations (AFL-CIO) affiliate having locals in most paid fire departments with membership chiefly of full-time professional fire fighters.

INTERNATIONAL FIRE SERVICE TRAINING ASSOCIATION: An association of state and local training officials and insurance industry representatives which meets regularly to approbate fire service training tests published with the cooperation of the Fire Protection Department of Oklahoma State University at Stillwater.

IGNITION: The beginning of flame propagation or burning. The starting of a fire.

IGNITION TEMPERATURE: The temperature at which a fuel ignites and flame is self propagating.

IMPELLER: That part of a centrifugal pump which imparts centrifugal force to the water.

IMPERIAL GALLON: 1.201 U.S. gallons.

INADEQUATE SUPPLY: Usually in reference to an insufficient amount of water to cope with the degree of fire hazard at a given location and inadequate to meet AIA recommendations for water upply for "fire flow".

INCENDIARY: A fire believed to have been deliberately set. The person who perpetrates such a crime.

INCENTIVE PAY: Additional compensation above that normally provided per grade in recognition of training or education by individual members or toward payment of their tuition at educational institutions.

INCIPIENT: A fire of minor consequence or in initial stages.

INCLINOMETER: A device on a fire department aerial ladder showing the angle of elevation of the ladder. Usually, this also indicates the extension of the ladder and may include the maximum loading recommended by the manufacturer under prescribed conditions of use.

INCREASER: Increasing coupling used on hose, pump or nozzles to permit connection of a larger size of hose.

INDEPENDENT GAGE: A gage registering water pressure in psi on a particular device or pumper discharge connection as distinguished from a gage registering the general discharge pressure of the pump.

INDEPENDENT GATE: A gate valve provided to give independent control of a single 2-1/2" or 4-1/2" outlet. Use of independent gates on hydrants permits connection of additional lines or pumps without shutting down lines already in service.

"INDIAN" PUMP: Trade name for a 5-gallon back-pack fire extinguisher.

INDICATOR PANEL: An alarm panel indicating the source of a signal from automatic alarm or waterflow alarm in specified area of a protected property.

INDIRECT APPLICATION: Technique of injecting water particles into the upper atmospheric level of a fire within a confined space to generate steam and distribute unvaporized droplets to cool heated materials beyond the immediate reach of stream. A method of extinguishing fire by applying water fog into heated atmospheres to obtain maximum heat absorption, generation of steam and smothering action by converting 1 cu. ft. of water, 7.48 gallons into 1650 cu. ft. of steam which purges heated atmosphere. A 10 second application of a 50 gpm fog stream used in indirect application theoretically will absorb 77,773 BTU of heat and will generate 1831.5 cu. ft. of fire smothering steam, sufficient to fill a room 8 x 15 x 15 ft.

"INFLAMMABLE" A misnomer. Does not mean nonflammable.

INITIAL ALARM: The first notification or intelligence received by the fire department indicating that a fire or emergency exists.

INITIAL ATTACK: The first point of attack and hose lines employed to prevent further extension of fire and safeguard life while additional lines are being laid and placed in position.

INLET: An intake water supply connection usually on a fire department pumper to which suction or supply hose may be attached.

INLET GAGE: A compound pressure gage showing pressure at the intake side of the pump whether the pressure is above or below atmospheric.

"IN-LINE": Something inserted in a waterline used for fire fighting. For example, an in-line proportioner for introducing foam ingredients or wetting agents into a stream of water.

IN SERVICE: A company or other fire fighting unit reports "in service" when it is ready to resume its assignments upon completion of any fire or emergency duty. Usually a hose carrier must have 50% of its hose loaded before going in service.

INSPECTION: A fire prevention inspection conducted for the purpose of familiarizing fire department personnel with locations where fires may occur; removal of common or special fire hazards and enforcement of fire prevention ordinances and regulations.

INSPECTION BUREAU: A regional or state fire insurance bureau concerned with the fire protection of various communities and insured properties.

INSPECTION DISTRICT: An area assigned to a fire company, unit or command for the purpose of carrying out routine fire department inspections. This is usually a portion of the unit's first alarm or first due district. When several fire companies share the same quarters, each is usually assigned a separate inspection district in the area adjacent to the station.

INSTRUCTOR: A fire department training officer usually holding a certificate from an educational organization as a qualified fire instructor.

INSTRUCTOR TRAINING: A course in teaching techniques given to selected fire officers to prepare them for service as certified fire department instructors.

INVOLVED: Describes a building, area, room or structure either actually enveloped in the flame and smoke of a fire or in danger of such involvement.

JACKKNIFING: The spotting of a tractor-trailer type ladder truck with the tractor at approximately a 60 degree angle from the trailer to provide maximum stability for the vehicle when the aerial ladder is raised and extended.

JACK PLATES: Substantial plates, usually of metal, placed under the jacks of aerial ladders or elevating platform apparatus to enlarge the area of ground support and to distribute the load.

JACKS: Ground jacks for supporting turntable of aerial ladder, elevating platform or other elevating equipment. Also, heavy jacks used for rescue purposes.

JET: A stream of water from a fire nozzle.

JOURNAL: Day book or record book kept by company commanders or superior officers recording all activities, alarms visitors, etc., occurring on each work shift.

J-DAY: A rotating off-duty period in addition to the normal off-duty schedule of the platoon to which a fire fighter is assigned and originally provided to reduce the 72 hour work week of a straight 2-platoon system.

"KELLY" TOOL: Forcible entry tool similar to claw tool but having adz blade at top and forked blade at bottom.

KINK: To kink or bend hose back upon itself several times to cut off flow of water so that another length can be added or a burst section replaced. Also, an unwanted kink that restricts the flow of water.

KNOCK DOWN: To reduce flames and heat so as to prevent danger of further extension of fire. To bring a fire to the overhauling stage.

LADDER: A fire department ladder of varying length, type or construction. A ladder truck or ladder company. To ladder a building.

LADDER BED: The rack or racks in which ladders are carried on a ladder truck.

LADDER BED LOCK: A ladder device for securing the aerial ladder in bedded position for road travel. This lock must be released either manually or by appropriate control before raising ladder or platform booms.

LADDER CARRY: A method for carrying heavy fire department ladders.

LADDER COMPANY: A fire company manning a ladder truck and especially trained in ladder work, ventilation, rescue, forcible entry, salvage work. In most departments, ladder companies are second only to engine or pumper companies in number of companies in service.

LADDER LOCK: A control for engaging the pawls of an aerial ladder or control for securing a ladder in its bed when not in use.

LADDERMAN: A fire fighter assigned to a ladder or "truck" company. A fire fighter handling ladders at a fire.

LADDER PIPE: A heavy stream nozzle attached to an aerial ladder and usually supplied by 3" hose having a siamese intake at ground level and capable of being directed by a ladderman at the nozzle.

LADDER SPUR: A leveling device attached to ladder heels.

LADDER THE BUILDING: A command directing a ladder or truck company to place ladders at front, sides and rear of a "fire building" where accessible, with ladders to one or more windows on each floor for use in rescue and advancement of hose lines and one or more ladders to the roof to provide access for ventilation.

LADDER TRUCK: A large truck carrying fire department ladders and other equipment. In addition to 163 feet or more of ground ladders the truck may carry a power-operated aerial ladder or an elevating platform. Some ladder trucks are combination units carrying a pump, hose and water tank.

LADIES AUXILIARY: The official women's auxiliary group consisting of wives and sweethearts of fire department members.

LAY: A method or sequence of laying hose from fire apparatus such as a "straight lay" or "reverse lay".

LAY-IN: A command to "stretch" or lay out hose while approaching fire with apparatus.

LAYOUT: A distribution of hose on the fire ground to achieve certain tactical results. An order or command to make a hose lay. The act of laying hose from pumper or hose truck.

LEAD: A line of hose starting toward a fire from a pump or hose body.

LEADER LINES: One or more 1-1/2" hose lines attached to the end of a line of 2-1/2" or other large hose.

LEAVE: Period off duty from regular working tour or shift such as annual leave, sick leave, etc.

LEG LOCK: A method of securing oneself to a ladder by putting one leg between rungs and locking the foot around a rung or beam so as to be able to work with both hands free.

LENGTH: A 50 or 100 foot length of fire hose.

LIEUTENANT: Second officer of a fire company in command when the captain is absent and generally in command of one platoon or working shift. Shift supervisor within an alarm bureau or section supervisor in a fire prevention bureau.

LIFE GUN: A gun firing a projectile to which a cord is attached by means of which a life line can be sent to persons trapped in places inaccesible to ladders.

LIFE LINE: A hand line rope coiled for ready use in fire department rescue work. The line may be of Manila rope or other suitable fiber. An eye splice is frequently provided on one end.

LIFE NET: Originally a rope net for catching persons jumping from burning buildings but later a specially constructed canvas device with a folding circular metal frame and spring action.

LIFE SAFETY CODE: NFPA Standard 101, containing recommendations covering safety to life from fires in buildings.

LIFT: Distance in feet of elevation between a static source of water and the suction chamber of a fire department pumper.

LIGHTING UNIT: A special duty fire truck equipped with electric generators, floodlights, communications equipment and various electrically driven power tools.

"LIGHT WATER": Trade name of product of Minnesota Mining and Manufacturing Company for forming aqueous foam-forming solution developed in cooperation with the U.S. Navy for controlling flammable liquids' fires.

LINE: Usually referring to a line of hose but also to a rope, as "life line". Also "hose line" sometimes refers to a small piece of rope used to secure hose.

LINEN HOSE: An unlined fire hose formerly used for first aid standpipes or forest service use consisting of a linen or flax fabric without a rubber lining.

LINE UP. Fire company or unit lined up for inspection as at roll call or when official visitors are received.

LOAD OF HOSE: The total amount of 2-1/2" diameter or other large hose carried on a given fire truck. A standard hose body accommodates at least 1500 feet of 2-1/2" hose.

LOCATION: A specifically designated place to which fire apparatus is dispatched in answer to an alarm of fire.

LOG: A chronological record of events such as a "ship's log". Incorrectly used in reference to a "company journal" or a record of the progress of an extensive fire.

LONGEVITY: Period of time served in fire department. Seniority.

LOOP: A water supply main system having a feeded main extending in a loop making it possible to supply a given point from two directions and when adequately valved, minimizing the danger of interruption to supply.

LOSS: Replacement or restoration cost of buildings and contents destroyed or damaged by fire, usually less any depreciation.

LOSS OF PRESSURE: Sudden loss or drop in pressure of streams used to fight fire due to various causes such as pump or hose failures, water system failure or depletion, or operation of additional pumpers taking water from streams already in operation.

LOW PRESSURE: Usually a misnomer for an inadequate volume of water as indicated by a pressure drop when a pump attempts to supply hose streams.

LP-GAS: Liquefied Petroleum Gas. Any one of several petroleum products such as "Butane" or "Propane" stored under pressure as a liquid and vaporized and burned as gas.

LUGGING: A condition of engine overload resulting in failure to develop efficient engine speeds, frequently due to faulty operation such as failure to shift down as required for climbing a given grade.

MALE COUPLING: The threaded hose nipple which fits in the thread of a swivel coupling of the same pitch and appropriate diameter. A coupling to which nozzles and other appliances are attached.

MALICIOUS FALSE ALARM: A false alarm of fire deliberately sounded to inconvenience the fire department and to cause a disturbance or excitement rather than one sounded by accident or error.

MALTESE CROSS: The heraldic symbol of the fire fighter worn as a badge on the uniform cap of most rank and file fire fighters and derived from the cross of the Knights of Malta although the symbol now chiefly used in a modification of the cross pat'ee rather than the eight pointed maltese cross.

MANIFOLD: Water distributing device through which water received from supply lines is distributed to various discharge lines.

MASKS: Fire department gas masks which may be of canister filter type, air line or self-contained oxygen or air types.

MASTER BOX: A box connected to public fire alarm system or other fire alarm system which is arranged to transmit signals from auxiliary or remote alarm stations in a property or alarms from fire detection equipment or from automatic sprinkler systems.

MASTER STREAM: Any of a variety of heavy streams formed by siamesing two or more big lines into a single heavy stream device. Such streams are commonly operated at 80 to 100 psi NP for either solid stream or fog.

MECHANICAL FOAM: Mechanical or air foam include foam liquids of protein (low expansion) or synthetic types. Concentrates are provided in solutions of 3% or 6%.

MISCELLANEOUS CAUSE: A fire of known cause that cannot be properly classified under standard causes listed in fire cause statistics.

MOBILE: A fire department radio unit on mobile apparatus as distinguished from base stations.

MOBILE WATER SUPPLY APPARATUS: A class of fire apparatus included in NFPA Standard No. 19 having the primary purpose of transporting water to fires. A water tanker.

MONITOR: A large heavy stream nozzle controlled by wheel operated gears and provided on fireboats and on high pressure trucks in large cities. Usually provided with 2" or 2-1/4" tips or larger and throwing upward of 1,000 gpm.

MODEL ARSON LAW: A model law recommended by the Fire Marshals Association of North America and adopted in most states, dealing with the subject of arson.

MONITOR WAGON: A fire truck equipped with heavy stream devices and large hose. (Usually 3 or 3-1/2 inch.)

MOP-UP: A late stage of fire fighting in which remaining hot spots are cleaned up with small jets often from small hose connected to the tip of a shut-off nozzle.

MOUTH-TO-MOUTH RESUSCITATION: Act of breathing into the mouth of a person who has ceased breathing in order to force air into the victim's lungs prior to arrival of special resuscitation equipment.

MOVE-UP: Movement of fire companies from their home stations to cover vacated stations nearer to a major fire to give coverage to districts stripped of normal protection. Some move-ups are provided by automatic transfers following additional alarms while others are ordered by fire alarm dispatchers.

MULTIPLE ALARM: Usually an additional alarm such as 2nd or 3rd alarm which is a multiple of the first alarm, but also a call for additional assistance or response to several boxes or alarms usually for the same fire or emergency.

MULTI-PURPOSE EXTINGUISHER: A chemical fire extinguisher tested and listed as capable of handling fires in ordinary combustibles, flammable liquids and in electrical equipment.

MUSHROOMING: Extension of fire on upper floors due to pent up heat which reaches the upper parts of the building through unprotected openings and which spreads the fire laterally unless ventilation is speedily and properly conducted by fire fighters.

MUTUAL AID: Two-way assistance by fire departments of two or more communities freely given under pre-arranged plans or contracts on the basis that each will aid the other in time of emergency and also providing for joint or cooperative response to alarms near municipal boundaries.

NATIONAL BOARD OF FIRE UNDERWRITERS (NBFU). See American Insurance Association.

NATIONAL ELECTRICAL CODE: A code prepared by the NFPA National Electrical Code Committee for the purpose of safeguarding persons and buildings and their contents from hazards resulting from the use of electricity for light, heat, power, radio, signaling and other purposes.

NATIONAL FIRE CODES: A series of volumes published annually by NFPA containing all the current technical standards prepared by various committees as adopted by the Association.

NATIONAL FIRE PROTECTION ASSOCIATION: A nonprofit educational and technical association formed in 1896 with headquarters at 60 Batterymarch Street, Boston, Massachusetts 02110. Devoted to the protection of life and property from fire through development of fire protection standards and public education.

NATIONAL STANDARD THREAD: American national standard fire hose coupling screw thread. Dimensions for standard fire hose threads from 3/4" to 6" couplings are specified in NFPA No. 194. The standard 2-1/2" fire thread has 7-1/2 threads to the inch and the outside diameter of the male coupling is 3-1/16 inches.

NEEDLESS ALARM: An alarm of fire apparently given in good faith which proves to be needless because fire department assistance was not required.

NEGATIVE PRESSURE: An inaccurate term for pressures below atmospheric as recorded on a "Compound Gage".

NEGOTIATIONS: An orderly procedure for reconciling differences and coming to agreement between fire fighters and their employer.

NESTING OF LADDERS: A group of ladders stored in the same bed on a ladder truck, smaller ladders resting between the spars of the larger ladders as when a roof ladder is nested with a straight wall ladder.

NET: A fire department life net, formerly of rope, now a canvas device with a folding metal frame used for catching persons jumping from burning buildings.

NET PUMP PRESSURE: The total pressure energy expended measured in psi expended by a pump in discharging a specified volume of water per minute. This includes pump discharge pressure and pressure loss on suction side when drafting.

NIGHT WATCH: A tour at the watch or patrol desk (floor watch) during the night while other fire fighters are permitted to sleep between alarms.

NONCOMBUSTIBLE: A term applied to materials which will not ignite or burn when subjected to fire.

NONCOMBUSTIBLE CONSTRUCTION: That type of building construction in which walls, partitions are of noncombustible construction not qualifying as fire resistive.

NONFLAMMABLE: Will not burn under conditions normally found in fires. Opposite of flammable.

NON-STANDARD: Devices and methods not meeting fire protection standards such as those recommended by the National Fire Protection Association or not listed by recognized fire testing laboratories.

NOTIFICATION: Information from a citizen, central station or alarm device that a fire is underway.

NOZZLE: A metal device attached to hose or a hose outlet to restrict the area of flow in such a manner as to speed the velocity of the stream to form a jet that will be effective in reaching and controlling fire.

NOZZLE MAN: Man assigned to operate a fire department nozzle, usually on a hand line.

NOZZLE PRESSURE: The pressure in pounds per square inch at which water is being discharged from a nozzle.

NOZZLE REACTION: The counter force or thrust directed backward against the hose crew or nozzle holding device by water leaving the nozzle.

"O.D.": The outside diameter of a tube or conductor or coupling as contrasted with its "I.D." or internal diameter. The outside diameter is an important feature, particularly with reference to coupling design. For example, the hose bowl of a coupling must fit the OD of the hose jacket and the OD of the hose nipple must fit (with specified tolerance) the ID of the swivel coupling of the same basic thread pattern.

"ODM": Outside diameter of male thread.

OFFICER: A fire department member with supervisory responsibilities, either a company officer such as captain or lieutenant or a chief officer.

OFFICER IN CHARGE: The ranking officer in command at a fire. Officer in charge of any specific command. In general, the senior man of a given rank exercises command, but with equal rank the command may rest with the officer assigned to a given district.

OFF THE AIR: A break in radio contact with headquarters (or Alarm Bureau) by a fire company or chief officer. Radio Coe "10-9".

OFFICER TRAINING: Special training courses to prepare members for administrative responsibilities as officers and teaching special skills and subjects essential in good fire officers.

1-1/2": One and half inch hose and fittings. This is the size of hose used for the majority of fires inside of buildings where the fire is considered to be beyond the capacity of 1 inch hose, extinguishers or other small capacity equipment.

1000 GPM PUMPER: A large capacity pumping engine tested to deliver at draft 1000 gpm at 150 psi net pump pressure in parallel operation and 700 gpm at 200 psi. This apparatus is provided with four 2-1/2" discharge gate valves. Such apparatus is commonly provided in high value congested districts of cities where ample water supply is available for heavy streams.

OPEN HEAD SYSTEM: A fire protection sprinkler system having open sprinklers without fusible links and controlled by a valve that may be operated manually or by a thermostatic device.

OPEN UP: To ventilate a building filled with smoke and heat so that hose streams may be advanced to extinguish the fire and to avoid concentrations of unburned heated smoke and gases that might result in a hot air explosion Also, used in reference to forcible entry of a closed burning building.

OPERATING SUCTION LIFT: The vertical distance in feet between the pump center line and the water level plus the friction losses in suction hose, strainers and fittings.

OPERATOR: A fire alarm operator or dispatcher. An apparatus or pump operator or "engineer".

OUT OF SERVICE: A fire fighting unit reports out of service when due to accident, mechanical failure or any other cause and it is not available to answer its assigned calls.

OUT ON ARRIVAL: A fire found to have been extinguished prior to arrival of fire department equipment.

OUTRIGGER JACKS: Jacks designed to be extended outward from the slides of an aerial ladder or elevating platform fire truck to provide a wider base of support than provided by the width of the truck chassis.

OUTSIDE FIRE FIGHTING: Fire fighting conducted with streams directed from outside of the structure involved.

OUTSIDE SPRINKLER: A sprinkler system with open heads manually operated used to protect a structure and window openings against a severe exposure hazard.

OUTSIDE STANDPIPE: A standpipe riser on the exterior of a building usually adjacent to a fire escape and provided for use by the fire department and equipped with a fire department siamese at the base.

OVER THE AIR: Via radio.

OVERHAULING: A late stage of the fire extinguishment process during which the area involved in the fire and the contents involved are carefully scrutinized for any remaining trace of fire or embers and during which process, effort is made to protect property against further damage due to the elements, etc.

OVERLOAD: Gross vehicle weight in excess of the rated gross vehicle weight specified by the chassis manufacturer or in excess of axle ratings or permissible tire and rim loadings.

OVERLOAD TEST: A test required for new pumping engines to demonstrate ability to develop ten percent excess power and consisting of discharging rated capacity at 165 pounds net pump pressure for a short time.

OXYGEN: A gas present in the atmosphere in about 21% concentration, which while not combustible is an essential element in combustion and one of the four parts of the fire triangle. It is also the essential gas in respiration because the oxidation process is basic to life.

OXYGEN DEFICIENCY: Insufficient oxygen to support life or to support flame. Where oxygen content of the air falls below 16% flame production is reduced and fire fighters are in danger of asphyxiation from oxygen deficiency; below 6%, breathing ceases.

OXYGEN MASK: A self contained mask providing oxygen either through chemical reaction or from an oxygen storage tank.

PARALLEL OPERATION: Operation of a multistage pump with the several impellers contributing volume rather than serving as pressure stages.

PARAPET: Extension of wall above roof to prevent fire from overlapping.

PARTICLES: Three common types of radiation given off by unstable atoms include alpha particles, beta particles and neutrons.

PARTITION: A non-load bearing wall dividing interior space into rooms or other enclosures.

PARTITION NOZZLE: A nozzle with a curved or bent tip used for directing a stream upward or downward in partitions or other concealed spaces.

PART-PAID FIREFIGHTERS: Call firefighters who are paid on an annual or hourly basis but are not required ordinarily to be on duty in a fire station.

PATTERN: The shape of the discharge from a hose nozzle. The pattern from adjustable nozzles may range from straight stream to wide angle fog.

PAY OUT: To pull off or feed out hose or rope. To lay out.

PAWL: Part of the mechanism of an extension ladder whereby the beams of a fly ladder are secured to the rungs of the bed ladder as desired.

PEDESTAL: The operator's stand located on the turntable of a fire department aerial where the various ladder controls are located.

PENDANT SPRINKLER: An automatic sprinkler pointing downward from concealed piping rather than placed in upright position above the supply pipe.

PERFORMANCE TEST: The test conducted to determine whether new fire apparatus especially pumping engines, meet the specified pressure and discharge requirements. The test is usually witnessed by an underwriters' representative.

PERMANENT: A career fire fighter who makes his livelihood primarily as a member of a fire service organization with assigned duty periods in a fire department station as contrasted to firefighters on a call or volunteer roster.

PERMIT: Official permission given in writing by fire department or other enforcing authority allowing supervised burning, cutting and welding operations.

PHASE 1 or FIRST PHASE: A smoldering interior fire involving ordinary combustibles with oxygen content of interior atmosphere approximately normal (21%).

PHASE 2 or SECOND PHASE: Flame production period of an interior fire involving ordinary combustibles with oxygen content or interior atmosphere ranging from 21% to 15%.

PHASE 3 or THIRD PHASE: Dangerous smoldering period of an interior fire when oxygen content of atmosphere has been depleted below 15% presenting likelihood of back draft or explosion of confined heated smoke and gases if fire breaks through to outside or if building is carelessly ventilated.

PICK-UP: To take up hose and other fire fighting equipment that has been used at a fire and place it back on the fire apparatus to permit the company or unit to return to quarters.

PIECE OR PIECES: One or more sections or lengths of fire hose. A single piece or unit of apparatus.

PIERCING POLE: Wooden pole with metal point used to pierce ceilings to drain water during salvaging operations.

PIEZOMETER TUBE: A tube inserted into the flow so as to obtain at a connecting gage the pressure existing in the stream.

PIKE POLE: A type of plaster hook with metal head shaped in the fashion of an old-style battle pike.

PIN LUG COUPLINGS: Hose couplings where the lugs are pin shaped.

PISTON PUMP: A positive displacement pump using 2, 4 or 6 reciprocating pistons to force water from the pump chamber in conjunction with the appropriate action of inlet and discharge valves.

PITOT TUBE: A tube having an opening which is inserted into a stream of water from a nozzle and to which a pressure gage is attached to indicate the discharge pressure of the stream.

PLASTER HOOK: A barbed hook on a pike pole which may be of various lengths to permit puncturing and pulling down ceiling materials to give access to concealed fire.

PLATOON: An organized group of fire fighters who are assigned to work the same tours of duty and basically referring to on-duty and off-duty platoons of a given fire company but also to an entire on-duty or off-duty shift of a fire department.

PLUG: A term for a fire hydrant arising from the time when water for fires was obtained by removing a wooden plug from a water main.

POLE: Sliding pole, usually brass, used by fire fighters to descend from upstairs sleeping quarters to the apparatus floor.

POLES: Poles used to assist in raising long extension ladders. Tormentor poles.

POLE MEN: Men handling ladder poles during raising or lowering.

POMPIER: In American usage, a scaling ladder having a single spar or beam with rungs protruding on either side and a long curved hook which is placed over window sills when used in climbing. "Pompier" is from the French word for firefighter.

POMPIER BELT: Wide adjustable belt having snap hook which can be secured to spar of pompier ladder or a ladder rung to leave hands free. Hook is also used in sliding a rope or life line.

POMPIER CHAIN: A vertical row of pompier ladders extending from window to window and forming a means of access for fire fighting and rescue operations.

PORTABLE GENERATOR: A small electric generator carried on fire apparatus to provide power for electric tools and floodlights.

PORTABLE PUMP: A small gasoline driven fire pump designed to be carried on fire apparatus and capable of supplying either a direct stream through 1-1/2" hose or relaying a supply to a standard fire department pumper.

POSITIVE DISPLACEMENT PUMP: A pump of piston or rotary gear type which moves a given quantity of water through the pump chamber with each stroke or cycle. The positive displacement pump is capable of pumping air and thereby is self-priming.

POST HYDRANT: A normal fire hydrant, the barrel of which rises above the ground as distinguished from wall hydrants, flush hyrants, etc.

POST INDICATOR-VALVE: A post type valve showing open or shut position of sprinkler or other control valve in fire protection systems.

POTABLE WATER: Water fit for human consumption as in public water systems.

PRE-ACTION SYSTEM: An automatic dry pipe sprinkler fire control system wherein thermostatic devices are employed to charge the equipment before individual fusible links in sprinklers operate.

PRE-CONNECTED: Equipment connected for use prior to a fire. Ex: Suction or discharge hose carried connected to pump eliminates delay occasioned where hose and nozzles must be connected and attached at fire.

PRE-FIRE PLANNING: Practice of making specific plans for fire fighting operations at designated properties or locations and generally including inspection of the property, classroom instruction regarding procedures to be followed and pre-assignment of position and duties to units assigned to respond.

PRESSURE: Usually water pressure measured in PSI.

PRESSURE LOSS: Reduction in water pressure between a pump or hydrant and a nozzle due to expenditure of pressure energy required to move water through hose and including loss due to "back pressure" due to elevation and losses in fitting; i.e., difference between pump pressure and nozzle pressure.

PRESSURE OPERATION: Operation of a multistage centrifugal pump with impellers in series operation to provide increased pressure rather than volume. When in pressure, operation pressure is increased by passing water from one impeller to another. This is termed "series" operation.

PRIMING: Filling pump with water when pump is taking water which is not under a pressure head.

PRIVATE HYDRANT: Hydrant provided on a private water system for the protection of private property. Fire fighters should avoid connecting fire department pumpers to private hydrants as this is likely to deprive automatic sprinklers and other fire protection equipment of essential water supply.

PROBATIONARY PERIOD: A stipulated period usually of six months or one year during which fire service recruits are undergoing basic training and instruction. Normally, tenure is not secure until satisfactory completion of probationary work.

PROPORTIONER: A device for proportioning liquid foam "stabilizer" or wetting agent into streams of water. Usually installed on pumping engines or attached in-line or to nozzles.

PROTECTIVE CLOTHING: A general term for the complete ensemble of fire clothing such as firecoat, boots, helmet, turnout pants, gloves and gas masks and breathing apparatus.

PSI: Abbreviation for pressure measured in pounds per square inch and usually identified as pump pressure, nozzle pressure, friction loss in hose or pressure loss or gain due to elevation, etc.

PUMPER: A fire department pumping engine of at least 500 gpm rated capacity and carrying hose and other fire fighting equipment.

PUMP OPERATOR'S POSITION: The control position of a fire department pumper where the control instruments and gages are located.

PUMP PRESSURE: Water pressure maintained by operation of a fire department pumper as contrasted with pressure available from hydrant or gravity supply only. Modern practice requires that except where high pressure fire mains are provided the correct pump pressure should be provided on every fire department hose stream commensurate with the requirements of the nozzles employed.

"PURPLE K": Trade name for a dry chemical extinguishing agent of multi-purpose type manufactured by the Ansul Company.

"PYRO": Contraction of pyromaniac, a pathological fire setter as contrasted with a person's starting fires to defraud or to cover up other crimes.

PYROXYLIN PLASTIC: Nitrocellulose plastic materials which are extremely combustible, subject to deterioration and self-ignition, and which gives off toxic fumes.

QUAD: A "quadruple combination" fire fighting apparatus carrying a water tank, hose, pump and ladders. Better term is "Pumper-ladder" because this unit carries the standard equipment and appliances of both pumper and ladder trucks.

QUARTERS: The fire station to which a given fire company unit or individual is assigned. Example, after a fire, a company may be directed to return to its own quarters.

QUENCH: To extinguish a fire by soaking the fuel with water.

QUICK BURNER: A structure of generally flimsy construction, usually with unprotected vertical openings and combustible contents that would become rapidly involved in case of fire.

QUINT: A pumper-ladder truck having a mechanical aerial ladder in addition to the other four standard equipment components of a pumper-ladder or "quad" truck.

RADIOACTIVE: A term applied to various materials giving off alpha, beta and gamma particles and short-wave radiations either due to inherent activity such as in radium or due to exposure to such materials.

RADIUS: A straight line extending from the center of a circle or sphere to the circumference or surface.

RAISE: Any one of various accepted methods of raising and placing fire ladders which require the effort and teamwork of fire department members.

RATED GROSS VEHICLE WEIGHT (RATED GVW): The maximum approved gross vehicle weight for a truck unit, as specified by the manufacturer.

RATING BUREAU: A fire insurance bureau which sets fire insurance rates in a given territory.

"READY LINE" Generally, a preconnected line of hose with nozzle attached, connected to a pump and water supply ready for use.

REAR MOUNTED: Equipment mounted on fire apparatus either for operation from the rear of the vehicle or so as to place the load over the rear axle.

REDUCER: Reducing couplings used on hose or pump outlets.

REDUCING COUPLING: Couplings used to extend a line or hose with hose of a smaller diameter.

REEL: Hose reel, now chiefly used of "booster" or small hose reel (3/4 or 1 inch hose) supplied by water tank on the apparatus.

REKINDLE: An instance where fire department is called back to a location where fire has been extinguished because of reignition due to latent heat, sparks or embers or due to presence of smoke or steam.

RELAY: The use of two or more fire department pumpers to move water at distances which would require excessive pressures to overcome friction loss if one pump was employed at the source.

RELIEF VALVE: A pressure controlling device which bypasses water at a fire department pump to prevent excessive pressures when a nozzle is shut down. In general, engine speed governors are used for this service with centrifugal pumps.

RELOCATE: To order a fire company to the quarters of another company to carry out the first alarm assignments of the other company.

RESERVE: Apparatus not in first line duty but available in case first line apparatus is undergoing repair or available for use of off-duty fire fighters in abnormal emergency conditions.

RESET: To restore fire protection or detection equipment to service after it has been operated. As to reset a fire alarm box or reset a dry pipe valve.

RESIDUAL PRESSURE: Pressure remaining on the inlet side of a fire department pumper while water is being discharged from pump outlets. The amount of residual pressure as compared with the static pressure before pump discharge is started will indicate the relative volume of water that can be taken from the water supply coming into the pump from a hydrant or from a pumper relay.

RESPIRATORY PROTECTION: Protection equipment worn by fire fighters to prevent inhalation of smoke, gases and other products of combustion.

RESPOND: To answer an alarm in accordance with prearranged assignment or upon instruction of the dispatcher. To proceed to the scene of a fire or alarm.

"RESPONDING": Word indicating that orders to proceed to the scene of an alarm has been received and that the unit is underway.

RESTORE SYSTEM: Restoring an automatic sprinkler system to service after operation by opening control valve after sprinklers have been replaced and drain closed.

RESUSCITATOR: An approved mechanical device for assisting the respiration of unconscious persons, also containing the features of the inhalator.

REVERSE LAY: Hose laid from the fire to the hydrant or water supply.

RIG: A piece of fire apparatus, as "Go to the rig and get a hose clamp."

RISER: A vertical water pipe used to carry water for fire protection to elevations above grade as a standpipe riser, sprinkler riser, etc.

ROCKER LUG COUPLING: A hose coupling in which the lugs used for tightening or loosening are semi-circular in shape and designed to pass over obstructions.

ROOF LADDER: A single section ladder provided with folding roof hooks by which the ladder may be hooked over the ridge of a roof.

ROTARY GEAR PUMP: A positive displacement pump employing closely fitting rotors or gears to force water through the pump chamber.

RULES AND REGULATIONS: Official rule book of the fire department promulgating responsibilities of officers and members of different ranks and how fire department business is to be conducted.

RUNG: The round or step of a ladder.

RUNNER: Canvas or plastic 3' x 18' used to protect carpets within structures from firefighters tracking soot, ash, dirt or mud.

RUNNING CARD: A card showing fire company assignments for a given alarm box or location on various alarms from first to 4th or 5th.

RUNNING FIRE: An outside fire spreading rapidly with a well defined heat or front.

RUNOFF: Water from hose streams which runs from a fire area in liquid form as distinguished from water which has absorbed sufficient heat to vaporize. Water which is heated above 212 degrees F and vaporizes absorbs approximately six times more heat as the same quantity of water which remains in liquid state.

RUNWAY: Salvage covers folded along their length and interlocked to make runway through which water can be pushed.

ST. FLORIAN: Patron saint of fire fighters.

SALVAGE: Procedures to reduce incidental losses from smoke, water and weather during and following fires. The use of waterproof salvage covers is one of the chief means that fire departments use to prevent water damage. Smoke ejectors and deodorants are also used.

SALVAGE COMPANY: An organized company or unit specializing in fire salvage or protective duties.

"SCUBA": Self Contained Underwater Breathing Apparatus.

SCUPPER: A form of drain opening provided near the floor level to remove water through the walls to the outside of a building as a means of reducing possible water damage from sprinklers and hose streams.

SEAT OF FIRE: Area where the main body of fire is located as determined by the outward movement of heat and gases and where the fire is most deep seated.

SECOND ALARM: A signal ordered by the person in charge of the fire indicating that a full second alarm assignment is needed. In addition to engine and ladder companies, a "2ND" usually brings high ranking officers and special duty units which only respond to more serious fires.

SELF-CLOSING FIRE DOOR: A door which is normally kept in the closed position and which if opened is returned to closing position by a closing device.

SERIES OPERATION: Operation of a multi-stage pump so that water passes through each impeller consecutively to build up pressure rather than simultaneously to provide volume as in parallel operation.

SERVICE TEST: Test required annually and after major repairs to indicate whether a pumper is in good working condition and is capable of providing its rated capacity.

S HOOK: Hooks placed through grommet holes and used to secure salvage covers.

SHOP: The fire department maintenance or repair shops.

SHOULDER CARRY: A method of carrying hose on the shoulders.

SHUT-OFF NOZZLE: A common type of fire hose nozzle permitting flow of the stream to be controlled by the men at the nozzle rather than only at the source of supply. A controlling nozzle.

SIAMESE: A hose fitting for combining the flow from two or more lines of hose into a single stream. Some assert that a siamese is a 2-way connection only and object to "3-way siamese" and "4-way siamese", although the usage is common and is understandable.

SIDEWALK FIRE CHIEF: A spectator who stands on the sidewalk at a safe distance from fire and smoke and proclaims his opinion as to how the fire should be fought.

SIDEWALL SPRINKLER: A sprinkler designed to be installed on piping along the sides of a room instead of normal spacing.

SILENT ALARM: An alarm for which no audible bell or signal is sounded and to which response usually is limited to one or two company units. A still alarm.

SIZE UP: is the mental evaluation made by the officer in charge which enables him to determine a course of action and includes such factors as time, location, nature or occurrence, life hazard, exposures, property involved, nature and extent of fire, weather and fire fighting facilities.

SKID HOSE LOAD: A load of hose especially arranged on top of a standard hose load to permit dripping a working line at the fire. A skid load may consist of two 1-1/2" lines connected to a 2-1/2" hose load by reducing wye.

SLEEVE: Suction or supply hose.

SMALL LINE: A line supplied from the water tank on the apparatus, originally a 3/4 inch rubber covered line, now more commonly 1" or 1-1/2" hose supplied by water tank.

SMOKE: A combination of gases, carbon particles and other products of incomplete combustion hindering respiration and obscuring visibility and access to the seat of a fire.

SMOKE CONDITION: Smoke from an unknown source in a building or area and which requires investigation by the fire department to determine whether a fire is in progress.

SMOKE EJECTOR: A gasoline or electrically driven blower device sometimes provided with flexible tubing used to eject smoke from burning buildings and sometimes used to blow fresh air into a building to assist in purging smoke.

SMOKE EXPLOSION: An explosion of heated smoke and gases which have been pent up in a burning building when air is admitted completing the fire triangle of fuel-heat-oxygen. A misnomer.

SMOLDERING: A very low stage of combustion with little heat or flame and mostly smoke evidenced. Phase 1 of a fire.

SNAP COUPLING: Coupling devices of a type that snap together instead of using screw threads for attachment.

"SNORKEL": Name given to hydraulically operated elevating platform fire apparatus. An air intake and exhaust pipe protruding above water used to supply air to engines or swimmers under water.

SOCIETY OF FIRE PROTECTION ENGINEERS: An organization of professional fire protection engineers forming a sectional organization of NFPA.

SOFT SLEEVE: A short length of large diameter cotton-rubber-lined hose used to supply pumpers with water from fire hydrants usually through the "steamer outlet." Such hose is preferred to hard suction for hydrant connections because it is easier and quicker to handle.

SOFT "SUCTION": An erroneous but commonly accepted term for a short length of large diameter hose used to connect a fire department pumper with a hydrant. No "suction" is involved because the hose is useful only when the pumper receives water at pressures above atmospheric.

SOLID STREAM: A stream of water used for fire fighting and discharged by an open round orifice and at effective pressure providing a stream having impact and range. Also a straight stream.

"SPAGHETTI": An extensive snarl of charged hose lines from various fire companies usually in the street adjacent to the fire area.

SPANNER: A metal wrench device used in tigtening and freeing hose couplings.

SPAR: The side rails or beams of a ladder as distinguished from the rungs.

SPECIAL ORDER: An official fire department order covering special circumstances not covered in the official rule book and distinguished from general orders in that the special order usually applies to a more transitory situation or circumstance.

SPILL FIRE: Fire involving ground spill of flammable liquids often involving intense heat and flame due to relatively large surface for evaporation of liquid.

SPLIT LOAD: A hose load which is divided for laying hose in several ways such as fire to hydrant and hydrant to fire. A divided hose body.

SPONTANEOUS HEATING: Heating due to chemical or bacterial action in combustible materials which may lead to sontaneous ignition and fire.

SPONTANEOUS IGNITION: Ignition and fire due to self heating process encountered in certain fuels such as damp hay, linseed oil soaked rags, etc. which slowly oxidize or heat by bacterial action until the ignition temperature is reached and active flame propagation starts. Misnomer, "spontaneous combustion".

SPOTTING A LADDER: Positioning a fire ladder with reference to the objective to be reached. Normally this is the responsibility of the officer in charge of a ladder company.

SPREADERS: A wedge type emergency tool usually of hydraulic operation used to force apart structural members to assist in the release of trapped persons.

SPRINKLER: An automatic sprinkler or an automatic sprinkler system for extinguishing fires.

SPRINKLER SPACING: Distribution of automatic sprinklers to provide the number of square feet of coverage specified for light hazard, ordinary hazard and extra hazardous locations as set forth in NFPA Standard No. 13.

SPRINKLER STOPPER: One of several devices for stopping the flow from individual sprinklers.

SQUARE OF DIAMETER: A diameter multiplied by itself. For example, with a 1-1/4" nozzle tip, the square of the diameter is 1.5625, (1.2500 x 1.2500). The flow from any size circular orifice may be compared with the known flow from a 1" tip by multiplying by the square of the diameter.

SQUEEGEE: A rubber edged device for removing water from floors.

STANDARD COUPLING: A fire hose coupling having American National Standard fire hose threads.

STANDPIPE: A vertical water pipe riser used to supply fire hose outlets in buildings. Fire department standpipes have 2-1/2" hose outlets and are supplied by a fire department type siamese connection near the ground level.

STATIC PRESSURE: Water pressure head available at a specific location when no flow is being used so that no pressure losses due to friction are being encountered. The static pressure is that pressure observed on the pumper inlet gage before any water is being discharged from the pump.

STATIC WATER SUPPLY: A supply of water at rest which does not provide a pressure head for fire fighting, but which may be employed as a suction source for fire pumps.

STEAM: Properly, invisible water vapor at 212 degrees F or more.

STEAMER OUTLET: The large outlet on a hydrant provided for supplying fire department pumpers.

STILL ALARM: An alarm of fire for which no box alarm or audible signal is sounded over the fire alarm telegraph system but which is announced only to the unit concerned. Usually, the alarm is sounded via the manual alarm system mounted outside the station door or verbally announced by a passerby.

STRAIGHT STREAM: A Stream projected straight from the nozzle as contrasted with a fog or spray cone.

STRAINERS: Strainers used in pumps and on suction hose to keep foreign material from clogging or damaging pump.

STRATEGY: The overall method and plan for controlling an outbreak of fire with most advantageous use of available forces by the chief officers through assignment of positions through which tactical fire fighting can best be carried out.

STRETCH: A command to lay out hose in a long continuous line.

SUCTION: Practice of taking water from static sources located below the level of the pump by exhausting air from the pump chamber and using atmospheric pressure (14.7) to push water through non-collapsible suction hose into the pump.

SUCTION HOSE: A hose reinforced against collapse due to atmospheric pressure used when drafting water into fire pumps.

SUCTION LIFTL As used in the fire service, this refers to the number of feet of vertical lift from the surface of the water to the center of the pump impeller.

SUPER PUMPER: Mobile pumping station operated by the New York City Fire Department for service at major fires. Pumping unit is capable of discharging 8800 gpm at 350 psi and 4400 gpm at 700 psi. Operated in conjunction with satellite units carrying 4-1/2" high pressure hose and heavy stream nozzles.

SUPPLY LINE: A line of hose laid to supply a pumper or other apparatus at a fire as contrasted with an attack line directly from a pumper discharge valve to a nozzle. A feeder line.

SUPPRESSION: The total work of extinguishing a fire beginning with its discovery.

SUSPICIOUS: Designation of the cause of a fire for which exact cause remains to be determined but which because of unusual circumstances may have been due to incendiary origin.

TACHOMETER: A device for measuring engine speed, from Greek "Tachos" - Speed + Meter meaning measure. The tachometer on a pumping engine provides indication that the engine is operating at a safe speed and correct gear ratio for pumping.

TACTICS: Methods of employing engine, ladder and other fire company units in an efficient coordinated manner in the field so as to get satisfactory results with the forces employed and to deny the fire any potential avenues of extension. Tactics include methods of successful field operations while strategy includes the planning and disposition of units necessary to permit such operations.

TAILBOARD: The back step of a hose or pumper truck on which fire fighters stand while riding on the apparatus. The tailboard is also used to carry donut rolls of wet hose while returning to quarters and is the station for fire nozzles and various hand extinguishers.

TAKE CHARGE: To assume command of a unit or fire fighting operation usually on a basis of rank, seniority or prior designation.

TANDEM: Basically, one behind another. With pumpers, it is used to describe an operation with short lines between pumps. In some cases a pumper at a hydrant supplies a second pumper either through a short discharge line or by connecting suction inlets of the two pumps by a length of suction hose.

"TANKER": Mobile water supply fire apparatus specified in NFPA Standard No. 19, with water tank capacity of 1000 or more gallons. May be equipped with either a standard fire pump or a booster pump.

TELESCOPIC BOOM: A power operated boom constructed with retracting sliding sections like a telescope and used as a support for some elevating platforms used in fire fighting.

TEST FIRE: A fire set to evaluate such things as fire behavior, equipment or personnel performance, or control measures.

THERMAL COLUMN: Column of smoke and gases given off by fires moving upward because heated gases expand and become lighter and rise while cooler air bringing additional oxygen is drawn in toward the base of a fire.

THERMAL RADIATION: The emission of radiant energy waves in forms transmitting or producing heat.

THERMAL TURBULENCE: Atmospheric disturbance sometimes rather violent above and downwind of a major fire due to the effect of the rising column of heated gases being displaced by cooler air.

THERMOCOUPLE: A device used to record fire temperatures.

THERMOSTAT: A heat sensitive device used to give notification of fire as evidenced by abnormal heat and also used to actuate controls for various types of equipment.

THREAD: The specific dimensions of a screw thread employed to couple fire hose and equipment. Specific dimensions are found in NFPA Standard No. 194.

THREE BAY HOUSE: Fire station with three bays for housing apparatus, usually including pumper, ladder truck, chief officer's car or rescue truck.

THREE PLATOON: Division of a fire force or company into three groups with duty tours averaging 56 hours per week each. The 56 hour work week is the maximum permitted for fire fighters by law under normal conditions in some areas.

THROUGH THE ROOF: Visual indication that flame has gained sufficient headway so that fire has vented itself by burning through the roof structure, as "Fire was through the roof on arrival."

THROW: To raise a ladder quickly. To throw water as in a stream from one or more nozzles. Often used in connection with rate of discharge as "Throwing 600 gpm". Spreading salvage covers quickly by approved means.

THROWING COVERS: To spread salvage covers at a fire.

TIED-UP: A fire company engaged for a period of time and not available to cover its district. A pumper connected to a hydrant. Apparatus delayed when responding by traffic or snow.

TIE-IN: Securing oneself to a ladder or other object with a rope hose tool, belt or leg lock. Also, to cut a pump or hose into a line already laid such as a pumper relay.

TILLER: The rear steering wheel on a large tractordrawn ladder truck or other vehicle requiring a separate steering wheel for the rear axle.

TILLERMAN: The man who operates the wheel to steer the rear axle.

TIME OF ARRIVAL: The time as indicated on the radio log at which the first unit or officer of the fire department assigned to respond, reports on the scene of a fire or incident. Also, arrival time of other assigned units or officers as reported to the dispatcher.

TIPS: Nozzle tips for changing the size of orifice of a hose stream.

TORCH: A person employed to set fires for fraudulent purposes. Also, in former times, torches carried to fires to light the streets and firegrounds.

TORMENTERS: Poles attached to long extension ladders to assist in raising and controlling same. Sometimes separate crotch poles to support ladders.

TOUR OF DUTY: Any given on-duty period worked by a group or platoon of fire fighters.

TOWER: Variously referring to training or drill tower, a fire department water tower truck, a hose drying tower.

TOWER-LADDER: A hydraulically operated telescopic boom elevating platform with ladder for fire fighting and rescue work.

TRACTOR-DRAWN: A fire fighting vehicle having a separate four wheel automotive vehicle with a "fifth-wheel" connection for drawing a two-wheel trailer carrying the fire fighting equipment.

TRAILER PUMP: Pumping equipment usually mounted on a two-wheel trailer for towing by automotive vehicles.

"TRAILERS": Long trails of fast burning materials used by arsonists to rapidly spread a fire throughout a structure. Materials are usually chosen which if completely burned, leave little ash or telltale residue.

TRIPLE: A triple combination pumper operating as a unit without accompanying hose truck or attack pumper.

TRIPLE COMBINATION: A combination pumping engine combining hose, water tank and pump apparatus.

TRIPLE HYDRANT: A hydrant barrel having three outlets, usually two 2-1/2" and one 4 or 4-1/2" outlet.

TRUCK COMPANY: A ladder truck company with special reference to the large assortment of special emergency tools carried and the crew of men skilled in their use.

TRUCKMEN: Fire fighters assigned to ladder or truck company. Also referred to as laddermen.

TRUMPETS OR "BUGLES": An insignia of rank used throughout the fire service dating back to the time when commands were given through speaking trumpets. Common usage:

Five gold crossed trumpets: Chief of Department
Four gold crossed trumpets: Deputy Chief
Three gold crossed trumpets: Assistant Chief
Two gold crossed trumpets: Battalion Chief
Two silver trumpets (not crossed): Captain
One silver trumpet: Lieutenant

TRUSS: A truss member of a fire ladder joining and supporting the ladder beams or rails. Some ladders are single trussed with rungs set in the rails. Others are double trussed with rungs set in truss blocks.

TRUSSED LADDER: A ladder built of truss construction to provide greater strength for a given weight as compared with a ladder of solid beam side construction.

TURNOUT COAT: A waterproof-lined fire coat with snap fastenings which may be donned quickly when turning out on an alarm of fire.

TURNOUTS: Fire clothes worn when turning out to an alarm of fire.

TURNTABLE: The rotating table or platform at the base of an aerial ladder upon which the ladder operator stands.

TURRET: A heavy stream nozzle mounted on a pumper or fire boat and directly connected to the pumps, comparable to the gun turret on a naval vessel.

24-HOUR SHIFTS: Working shifts followed in a large number of fire departments in which 24-hour duty periods are followed by one or more like periods off.

2-1/2": Two and one-half inch rubberlined fire hose and connections for that size of hose which is the size in most common use in fire departments. This hose is used to move flows of approximately 250 gpm.

TOW-MAN FOLD: A fold for salvage covers which require two men to spread a cover so folded.

UNDER CONTROL: A fire sufficiently surrounded and quenched so that it no longer threatens destruction of additional property and has reached a phase where overhauling can begin.

UNDERWRITERS' LABORATORIES, INC.: Research and testing laboratories founded by capital stock fire insurance companies which test and list various items of equipment as meeting standards for safety.

"UNFRIENDLY FIRE": Any fire that is a threat and particularly an extension of a useful fire intended for heat or for industrial or other useful processes, which spreads to combustible materials of value which were not intended as fuel.

UNIFORM: Official dress uniform as contrasted with fire clothes.

UNIFORM FORCE: Members of the fire fighting force wearing uniforms as contrasted with civilian personnel of the fire department.

UNLINED FIRE HOSE: Fire hose commonly of cotton or synthetic fibre construction without rubber tube or lining.

UNIVERSAL COUPLING: A coupling device by which mismated couplings can be attached.

UNPROTECTED STEEL: Exposed steel structural members not protected against softening and failure due to heat. Unprotected steel has about 50% of the strength at 1000 degrees that it has at 100 degrees F.

UPON ARRIVAL: The point at which an individual chief officer or fire fighting unit complete their run or response to an alarm and are ready for action or assignment to fire duty.

VACATION SCHEDULE: Schedules for annual leave for individual officers and men scheduled to maintain required operating strength of various fire department units.

VACUUM: For fire service purposes pressure below atmospheric and shown in inches of mercury such as developed in a pump chamber by exhausting air during priming operations.

VAPOR DENSITY: The relative density of a vapor as compared with air. A figure less than 1 indicating a vapor lighter than air and a density above 1 indicating a vapor heavier than air.

VAPORIZING LIQUIDS: Halogenated extinguishing agents or liquids once used in fire extinguishers for Class B and Class C fires in fire department service. Most commonly employed was a special grade of carbon tetrachloride.

VARIABLE FLOW NOZZLE: A spray type nozzle which the operator can adjust to obtain variable predetermined flow rates at stated nozzle discharge pressures.

VELOCITY: Pressure energy directed in a given direction. The flow of water usually measured in cubic feet per second through a hose, pipe or nozzle.

VENTILATE: To effect ventilation, to open up.

VENTILATION: A technique for opening a burning building to remove heated smoke and gases to prevent explosive concentrations and to permit advancement of hose lines into effective positions for fire extinguishment.

VERTICAL OPENING: Opening through floors such as for stairways, elevators, conveyors or for purposes of light and ventilation. Unless enclosed and protected, such openings may serve as channels for spread of smoke and fire.

VOLATILE: Tendency to readily vaporize.

VOLUME OPERATION: Operation of a multi-stage centrifugal pump with impellers "parallel", i.e., each discharging its volume directly to the pump header supplying the discharge connections. This is the position used in supplying the rated capacity of the pump at its required net pump pressure for capacity operation. A rotary gear or piston type pump operated in capacity rather than pressure.

VOLUTE: Spiral casing surrounding the impeller of a centrifugal pump which collects water in a chamber of increasing cross-sectional area and which leads to the pump discharge connections.

WALKIE-TALKIE: A two-way radio hand set used for fire ground communications.

WALL HYDRANT: Discharge connections from stationary building fire pump protruding through the wall of a building or pump house and useful in testing pump and also furnishing hose outlets for fire protection in the immediate vicinity.

WALL LADDER: A straight single section ladder common in lengths up to 35 ft. and used for placement against walls as constrasted with a single section roof ladder having roof hooks.

WALL SPRINKLER: An automatic sprinkler designed for placement near a wall and arranged to project a spray into the area protected. Technically known as side wall sprinklers.

"WASH DOWN": Flushing down spilled combustible materials such as flammable liquids.

WATER BOMBING: Attack on forest and brush fires by dripping various water solutions containing fire retardant chemicals such as borate.

WATER CURTAIN: A row of outside sprinklers protecting a building from exposure fires. Hose streams placed to protect exposures.

WATER HAMMER: Impact energy due to sudden shutting of fire nozzles, proportional to the mass multiplied by the square of the velocity.

WATER HEAD: The water pressure caused by the height of a column of water. A column of water 100 ft. high provides a static head pressure of 43.3 psi.

WATER THIEF: A gated valve or breaching connection to permit bleeding of one or more 1-1/2" hose lines from a high line supplying a 2-1/2" or larger hose stream.

WATER TOWER: A unit of automotive fire apparatus with a portable maneuverable standpipe capable of providing a large capacity elevated stream.

WATER VACUUM (SALVAGE MASTER): A portable device used to pickup water from floors and carpets following a fire.

WATERWAY: The size of an internal passage for water in a piece of fire fighting equipment.

WET PIPE SYSTEM: An automatic sprinkler system in which the pipes are kept filled with water.

WET STANDPIPE: A building standpipe generally for first aid use and connected to a domestic water supply and equipped with first aid fire hose.

WETTING AGENT: One of various chemical additives used to modify the characteristics of water used for fire fighting by causing greater penetration or a reduction of surface tension of water droplets.

WET WATER: Water to which a wetting agent has been introduced.

WORKING FIRE: A fire which requires fire fighting activity on the part of most or all of the fire department personnel assigned to the alarm.

WORK WEEK: The average number of hours on duty per week worked by members of a fire department.

WOVEN-JACKET FIRE HOSE: Fire hose of conventional construction woven on looms from fibers or cotton or synthetic fibers. Lined hose has a rubber tube or lining inside.

WYE: A hose connection with two outlets, permitting two connections of the same coupling diameter to be taken from a single supply line. Also, reducing wyes permitting several smaller diameter lines to be supplied from one big line.